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EXAMINATION PAPERS.

THE results of the Science and Art, and the City and Guilds of London Institute, Examinations held last May at many centres throughout the country are now being issued. Most of our young electricians go forward to these examinations, so we have thought it best this year to print the questions that were set, just about the time when the expectations of our young friends would be raised and when they would be eagerly enquiring as to what success their answers had attained.

We have from year to year recorded our views upon the magnetism and electricity examination questions, and we have noticed a gradual improvement in the elementary and in the advanced stages, but we are sorry to say we have not been able to observe any improvement in the honours stage except that of holding a practical examination at South Kensington for those who are fortunate enough to have passed the written one.

This year there has been a still further and decided improvement in the elementary paper. The questions have been carefully considered and clearly put, and there is a decided effort to avoid stock questions and to try to find out if the candidate does actually understand leading principles. The elementary stage of the Science and Art magnetism and electricity examination has become a regular mine for which almost every provincial schoolmaster has made a "rush." Thousands of young boys and girls have been of late annually "crammed up" for it, and the Department throws away thousands of pounds every year on the results. If this elementary examination embraced (as it should do) a knowledge of the elementary principles and methods of measuring current, potential difference, and resistance, all this nonsense and waste of money would be stopped. The mere schoolmaster would soon find out that he could not cram young boys and girls up for that, and he would give up electricity for something with which he was more familiar, while the examination would be viewed with the same respect that the elementary stage of theoretical mechanics and mathematics now receives. The advanced magnetism and electricity examination seems sufficiently difficult, and we think it would be impossible to pass young men in it unless they had received a very thorough course of lectures and demonstrations.

We do not, however, think that the honours questions are what we have a right to expect for the class of candidates whom the Science and Art Department are supposed specially to encourage and benefit. The questions are, in our opinion, too theoretical and too far ahead of the advanced stage. We have no means of knowing what the practical examination (to which those who were so fortunate as to pass the written examination were subjected at South Kensington) was like, but we shall be glad to hear from any of the candidates what they were set to do, and with what appliances they were supplied. In fact, we shall be glad to receive the opinions of teachers and students of all stages, on these examinations, which have really become of national importance, seeing that so many thousands from all parts of the country annually compete under them.

TORPEDO BOATS.

GREAT activity appears just now to prevail in the construction of torpedo boats, and these aggressive little vessels are becoming more and more perfect and formidable. The *Ariete*, one of two similar boats built by Messrs. J. I. Thornycroft and Company for the Spanish Government, is the fastest vessel in the world. A note of her official trial, it will be remembered, appeared in the REVIEW last week. The *Ariete* is fitted with two of Mr. Thornycroft's patent boilers, which for safety, economy and rapidity in getting up steam, leave little to be desired. This and a sister vessel have been wired for electric lighting by Messrs. Clarke, Chapman & Co., of Gateshead. The current is derived from a Parsons turbo-electric generator placed under the forward conning tower, which gives about 20 ampères at an E.M.F. of 60 volts. A slate switchboard holds fusible cut-outs and two non-sparking switches, and hanging close by is a voltmeter. There are twenty-one incandescent lamps and a search light on board. When the incandescent lamps are running, the search light cannot be employed; but when it is used a resistance is inserted in series with it. A Mangin reflector is used, and there is a vertical adjustment on trunnions and two horizontal adjustments, so that the light may be turned on a pivot or run on rails, placed on a raised platform, from port to starboard. This appears to be a pretty complete electrical outfit for so small a vessel, the movements and operations of which will certainly be eagerly watched by electricians. We hear that the Brush Corporation is wiring two torpedo boats for the Danish Government, respecting which we shall no doubt be able to give our readers particulars shortly.

WE learn that the prospectus of a proposed company for exploiting the "Eclipse" primary battery is being circulated. The capital is to be £100,000 in £1 shares, 30,000 of which, considered as fully-paid, are taken by the vendors in part payment of the purchase money, and the balance of £70,000 offered for public subscription at par. The prospectus leads off with a paragraph which we, at all events, do not endorse, *viz.*, that the "Eclipse" is acknowledged by the Press to be the simplest and most effective electric battery that has yet been invented either for electric lighting in mines or in ordinary domestic life. It is also claimed that it is equally good for the supply of electric motive power for tramcars and sewing machines. The descent here from

the sublime to the ridiculous will not escape observation; sewing machines have been successfully operated by means of primary batteries, but tramcars, never! Official reports are to the effect that a brilliant and constant light may be maintained for eighteen consecutive hours at a cost not exceeding twopence. As the estimated candle-power of this intense glow is conspicuous by its absence further comment is almost superfluous; but is it not time that some other mode of singing the praises of primary batteries should be adopted? It appears that the company looks mainly to the sale of the lamps for mine and vehicle lighting, and for this purpose a good primary battery may find extensive employment, but is it not going beyond the limits of just remuneration to inventive genius to fix the purchase-money at £60,000, half in cash and the rest in fully-paid shares? Professor Silvanus Thompson says "there is money in it," but even he would not like to pay such a price for a primary battery, and take the risk of recouping himself by the ordinary course of commercial operations.

WHEN companies are promoted and the vendors, who are generally the promoters, desire to secure the co-operation of the investing public in order to make their schemes go, copious extracts from the reports of experts usually accompany the prospectus. These are almost invariably of such a nature as to be absolutely valueless except to the man who can read between the lines. We think the time has almost, if not quite, arrived for a good opening in a new line of business for those who choose to take advantage of it, and we feel convinced that shortly the "expert's expert" will arise and prosper amazingly. The expert's expert will be a man who must naturally be above the suspicion of being himself pecuniarily interested in any scheme whatever, and to him the investor will bring the expert's report and ask his advice thereon. In fact, any member of the new race of technical advisers might justly be dubbed an "Investor's Guardian."

MR. RECKENZAUN'S article on the durability of storage batteries, will enable our readers to form a very good idea of the many points which have to be considered in the construction of an accumulator. These very valuable apparatus are far from being perfect, but if everybody connected with their manufacture studied their details as carefully as Mr. Reckenzaun does, we should not have long to wait for a battery somewhat approaching one's ideal of what it should be.

A REFORM of the thoroughgoing type has just been effected at Montgomery, Ala. There are in that city 15 miles of street railway, and the cars were, until recently, drawn by mules. Just a month ago, however, every one of the mules was taken off the line, and the system has since been worked exclusively by Van Depoele motors. Montgomery is not a large city, as cities go in America, and our contemporaries in the States are remarking that it is in the smaller towns that the greatest progress is observable in regard to electric locomotion. The reason for this, it is suggested, is that the big companies, with hundreds of cars and thousands of horses, naturally prefer to watch the results obtained upon smaller systems before committing themselves to so gigantic a change as that of replacing animal power by electricity on their extensive lines. There is a firm conviction abroad, however, that the change must shortly come.

NINE or ten months ago we called attention to a paint introduced by Mr. Henry Crookes which possessed the quality of changing colour under the influence of heat. The usefulness of this pigment for indicating overheating in electrical conductors, or in the bearings of machinery, was obvious. It is now stated that Prof. A. M. Mayer used iodide of mercury 15 years ago, in precisely the same way that Mr. Crookes employs his paint, for indicating the overheating of various things.

THE magistrate at the Wandsworth Police Court holds that a gas meter is not infallible. In this dictum he is at variance with the Wandsworth and Putney Gas Light and Coke Company, who sued Mr. Walter Rye, of Putney, for the value of a quarter's gas supply, £12 17s. 7d. Mr. Rye's previous quarterly bills had never exceeded £7 16s. 5d., and in this particular quarter he had, so he said, consumed even less gas than in that which preceded it. He tendered £8 in payment, but this was refused. Witnesses were called who declared that the meter could not err, but Mr. Paget came to the conclusion that it could, and directed Mr. Rye to pay £8 only, at the same time awarding him £8 costs. If, as the result of this judgment, gas companies are a little less exorbitant in their charges, Mr. Rye will have earned the lasting gratitude of consumers.

PEOPLE are, perhaps, a little too ready when their gas bills show a tendency to increase in amount, to attribute the cause to the erratic conduct of the gas meter. Even when the meter indicates the passage of a quantity of gas which it does not seem possible can have been legitimately consumed, the solution of the problem may often be sought and found in another direction. There is little doubt, for instance, that in many houses a great deal of quiet leakage goes on, either at the burners, not properly turned off, or at bad joints. If householders mistrust their gas bills, they would do well to examine the conducting pipes before imputing inaccuracy to the meter or fraud to the company.

THOSE who hoped for something exciting in the shape of an electrical boat race across the Channel—and we confess that we were of the number—seem likely to be disappointed. From what we hear difficulties appear to have arisen in connection with the *Countess*, the vessel which was built to be run by means of Mr. Elieson's apparatus, and fears are entertained that she will scarcely be fit for racing this season. The *Volta*, however, if the accounts which reach us are correct, is in the best of trim and ready to meet any comer—of her own class. It will be a great pity if the project falls through, first, because an opportunity will be missed of demonstrating conspicuously the powers of electrically-propelled boats; and secondly, because the Poplar Hospital and the West Ham Poor Box, two deserving institutions, will probably be *minus* £25 apiece which would be theirs if the race took place and did not result in a dead heat. We are not quite sure, however, whether the arrangements were not carried to such an extent that the defaulters will be liable to pay forfeit. When articles of agreement are duly signed and sealed in proper sporting fashion, we believe the person failing to come to the starting post forfeits his money if he has staked it, or if he has not, is expected to hand it in forthwith.

EXPERIMENTAL ATTEMPTS TO OBTAIN ALUMINIUM BY THE DRY WAY.

By ALEXANDER WATT.

STARTING with a belief that aluminium would sooner or later be successfully obtained, from one or other of its natural combinations, by some process of furnace reduction not yet discovered, a series of experiments in this direction was instituted and pursued with a considerable amount of zeal, and a determination to succeed, if possible. In following up the subject, little heed was taken of the prior researches of others in the same field, but such combinations of material and conditions of working as suggested themselves, from day to day, were at once adopted, and the result of each experiment duly noted at the end of each successive trial. While it is more than probable that old ground was in many instances retraced in these investigations, it is also equally probable that new paths may have been traversed while seeking the nearest road to success. In many of the numerous trials the presence of metallic aluminium, in a state of extremely fine division, was frequently observed, but in all such cases it was found impossible to induce the finely-divided particles to "gather," as refiners term it, in the form of actual globules of metal. Moreover, in many instances—even when the crucible in which the operation was conducted, was covered—there was little doubt that the reduced metal was re-acted upon by the air while cooling, whereby its minute particles became re-converted into oxide. To prevent this from taking place many devices were adopted, some of which were at least partially successful, so far as the exclusion of air was concerned; the main difficulty, howevr, still presented itself—the fine particles of reduced metal invariably refused to conglomerate. The extremely low specific gravity of the metal and the high density of the fluxing materials necessarily employed, doubtless rendered the particles of reduced metal almost, if not absolutely, stationary within the body of the fused mass, being unable to move freely about so as to come in contact with each other, and even when thinner fluxes were introduced, these failed to assist the agglomeration of the minute particles, owing to their inability to combine, even mechanically, with the body of material under treatment. While these observations may tend to explain some of the reasons why this important metal has not as yet been obtained by any direct method of smelting, I am still of opinion, after having made a great many fruitless attempts, and some few of a somewhat more hopeful character, that aluminium will eventually be obtained by some process of furnace reduction.

1. When fusing some chloride of sodium one day, I accidentally dropped a small piece of coke into the molten mass, when I observed that flashes of yellow flame appeared at several points around the lump of coke, accompanied by sharp explosions, and that this action kept up for a considerable time. It being suspected that the carbon was decomposing the salt and liberating its sodium, it occurred to me to utilise the fact in connection with the reduction of aluminium, to carry out which the following experiment was made:—A quantity of fused common salt was reduced to a fine powder, and intimately mixed with an equivalent proportion of finely-powdered charcoal. To this was added alumina in fine powder, and the whole well mixed together; the mixture was then placed in a clay crucible and well pressed down. A layer of china clay was placed above this to exclude air as far as possible, and the vessel was finally covered by its lid. The crucible was then placed in a clear fire and gradually heated until it ultimately attained a full red heat, which was sustained for about half an hour. The crucible was then withdrawn and set aside until cold, when the upper stratum of china clay was removed, the vessel broken up and its contents examined. This experiment was unsuccessful, however, there being no appreciable evidence of the presence of free aluminium.

2. Finely powdered alumina and coal were intimately mixed and put into a crucible, and well rammed down. The vessel was then covered, and gradually heated to a full red heat, which was kept up for some time. There was some evidence of free aluminium in the resulting product, but not sufficient to render the operation of any practical value.

3. Alumina, carbonate of soda and charcoal, all in fine powder, were well mixed, in equivalent proportions, and heated in a crucible. In a short time copious sodium flames appeared on the surface of the mass; the vessel was then closed, and moderate heat kept up for an hour or so. On examining the contents of the crucible, after cooling, it was found that there was considerable evidence of free aluminium, in a very finely-divided state, but there were no globules.

4. A portion of the above product was mixed with powdered fused common salt and chloride of potassium as a flux, and the mixture placed in a crucible and heated to bright redness for a considerable time, but no metallic globules were found.

5. Kryolite, in fine powder, was mixed with powdered coke, and the mixture placed in a plumbago crucible, which was then heated to bright redness. At this point, the molten contents of the vessel ran out, through a hole which had been formed in the bottom of the crucible, by the action of the double fluoride (kryolite) upon the silica with which the graphite of the crucible had been mixed in course of manufacture. There were traces of free aluminium in the fused matter that had run from the pot, but in no appreciable quantity.

6. A porcelain tube was closed at one end with a packing of asbestos, enclosing a piece of clay tubing, with a small orifice, for the escape of gases. The opposite end of the porcelain tube was fitted with arrangements for connecting with an ordinary gas burner. The tube was now charged with a mixture composed of alumina and chalk, both in fine powder, and in equal proportions, and then gradually heated to bright redness. At this point the tap of the gas burner was turned about half way, and a moderate flow of gas allowed to pass into the tube. While the operation was in progress the tube was occasionally turned, a little way at a time, so as to expose fresh surfaces of the heated material to the action of the stream of gas. In order to prevent the entrance of air until the material was perfectly cold, the gas was allowed to pass through the tube until the following day, when it was turned off, and the contents of the tube then examined. There was in this case evidence of free aluminium, but not in appreciable quantity.

7. In a porcelain tube, adjusted as before, for the passage and escape of a stream of gas, was placed a mixture of kryolite and chalk, each in fine powder, and in equal proportions. Soon after heating up, a portion of the kryolite in a fused state escaped through the asbestos packing, and thus marred the experiment. On examining the unfused material, which was found in the tube when cold, traces of aluminium were distinctly apparent, but there were no globules of the metal.

8. Alumina, chalk and charcoal, all in fine powder, and intimately mixed, were placed in a porcelain tube and gradually heated to bright redness, the heat being kept up for about an hour, when the tube was allowed to cool. On examining the contents, only traces of free aluminium were found.

9. Powdered kryolite, salt and chloride of potassium, were put into an iron crucible and fused, the two latter being fused first and the kryolite then added. Small pieces of zinc were then dropped into the crucible, when yellow sodium flames, with a crackling noise, flashed on the surface of the molten material. The zinc soon disappeared by volatilisation, whereas it was hoped that a fluoride of zinc would have been formed, setting free the aluminium. This was not the case, however. Fragments of copper were afterwards introduced, but with no advantageous result.

10. A Cornish clay crucible was thickly lined with a mixture of plumbago, chalk and carbonate of soda,

worked into a thick paste with water. The lining was allowed to dry thoroughly, when the crucible was gradually heated to dull redness. Fused kryolite was then poured into the crucible and the heat gradually increased; sodium flames soon appeared upon the surface of the melted mass, but more especially in the direction of the lining. When the sodium jets ceased to appear, the crucible was withdrawn and allowed to cool. The pot was then broken and its contents examined. There was some little evidence of aluminium in the mass, but no appreciable quantity.

11. Kryolite, common salt and chloride of potassium were fused in an iron crucible. An iron cup, filled with a mixture of dried carbonate of soda and powdered charcoal, well rammed down and covered by a perforated lid, was carefully lowered into the molten mixture, and allowed to rest on the bottom of the crucible. In a few moments sodium jets appeared all over the surface of the fluid, and continued to do so for about two hours; when these ceased to appear the crucible was withdrawn, and the contents poured out to cool. In this case there was but little evidence of aluminium in the resulting product, the sodium having escaped as soon as set free, without decomposing the fused kryolite in its passage.

12. An iron cup was filled with powdered coal, well pressed down, and then covered with a perforated lid, as before; this was placed at the bottom of an iron crucible, which was then put into a clear fire. A quantity of red hot, but not melted, kryolite was now poured into the crucible and an endeavour made to apply only sufficient heat to keep the kryolite in a heated, but not molten state. This was only partially successful, however, for the heat at the bottom of the crucible caused a portion of the kryolite to fuse. After thus heating for some time the vessel was withdrawn and allowed to become cold. In the result traces of free aluminium were found in certain portions of the mass, but the operation on the whole was unsuccessful.

13. Alumina, coal, carbonate of soda, and chalk, all in fine powder, were placed in a clay crucible and gradually brought to a red heat, which was sustained for about half-an-hour. In the result free aluminium was found in appreciable quantities, but, as before, not in the form of globules, and, therefore, not separable from the mass.

14. Small coal, kryolite, chalk and carbonate of soda were mixed together and put into a clay crucible, which was then gradually heated to redness. The resulting mass, when cold, was examined, and traces only of free aluminium were found.

15. A mixture of kaolin and finely powdered kryolite was made red hot in a crucible, and when in this state the mixture was emptied into a second crucible, on the bottom of which was a lump of coal. The latter crucible was then covered and heated to redness for some time, or until the combustible matters of the coal were entirely dissipated. There was but little evidence of free aluminium in the result.

16. Powdered kryolite, sand and charcoal were well mixed and heated in a Cornish clay crucible for about one hour, after which the crucible was withdrawn and allowed to cool. On examining the contents, there were decided traces of aluminium, but in such a finely divided condition as to be irrecoverable.

17. Precipitated silica, hydrate of alumina, kryolite and charcoal were intimately mixed and heated in a crucible to bright redness. The resulting compound, after cooling, gave evidence of the presence of free aluminium, but in the same impalpable state as in the former cases.

18. Kryolite and chalk, each in fine powder and well mixed, were heated to bright redness for half-an-hour or so. The resulting mass in this case, also, gave traces of aluminium. (*To be continued.*)

Electric Railways.—An electric railway is projected for Karlsbad, and a concession for the undertaking has been obtained by a company from the Austrian Minister of Commerce.

WRITING TELEGRAPHS.

INSTRUMENTS called autographic telegraphs have been known for years. Copying telegraphs would be a more appropriate name for them, because the messages are first written with insulating ink on tinned paper, and then fed into instruments adapted to transmit them. They are received on chemically prepared paper in the receiving instrument, but for a variety of reasons these apparatus have never proved a commercial success.

The system of the Writing Telegraph Company of New York is entirely different. The operator writes with a pen upon a strip of paper, which moves steadily beneath it. The movement of the pen in writing sends varied currents into the line, which actuate the receiving instrument and cause the pen thereof to reproduce a *fac simile* of each letter as it is made at the sending station. Common writing paper and ink are used.

The first to invent this system, and an apparatus therefor, was Edward Alfred Cowper, whose method was described at length in the ELECTRICAL REVIEW for March 1st, 1879. According to his method, the movement of a pen at the sending station introduced varying resistances into two electric circuits connected with the receiving station, so that the varying currents, in acting upon two electro-magnets at the latter station, caused these to impart movements in two directions at an angle to each other, to the receiving pen, whereby this was made to reproduce the writing produced by the sending pen.

FIG. 1.—TRANSMITTER.

Mr. J. Hart Robertson, an American electrician, not knowing of the achievement of Mr. Cowper, invented an improved instrument on the same plan, but finding the expense of operating would be objectionable, he continued his experiments until he had invented and perfected the present system of changing the strength of the electric currents when writing by the movements of the pen, varying the pressure on a series of carbon discs, included in the circuits, thus securing simplicity, greater speed and the utmost accuracy in the reproduction.

Mr. Cowper protected his invention in the States, and his patents are the property of the Writing Telegraph Company, who also hold those of Mr. Robertson.

The instruments have been adapted for commercial use, and are now said to be ready for the public.

The transmitter consists of two series of carbon discs, placed at right angles to each other, in a hard rubber receptacle. Each pile of discs is provided with a screw follower for adjusting the normal pressure of the discs on each other. The rod which carries the pen or

stylus is pivoted at its lower end, and has pressure points opposite the piles of discs. As the operator manipulates the pen or holder—as in writing—the pressure points are pressed against the carbon discs, and as this pressure is increased or diminished, varied currents are sent into the lines to the receiving magnets—which cause the receiving pen to reproduce every movement of the pen of the writer at the sending station.

The receiver consists of two electro-magnets, arranged at right angles to each other, and at the point where the poles would reach, if extended, is located a carrying rod for carrying the armatures. Near where the rod is pivoted at the bottom, a spring is inserted so that its armatures can easily and quickly respond to the varying attraction of the electro-magnets. The armature rod extends above the table and carries the receiving pen.

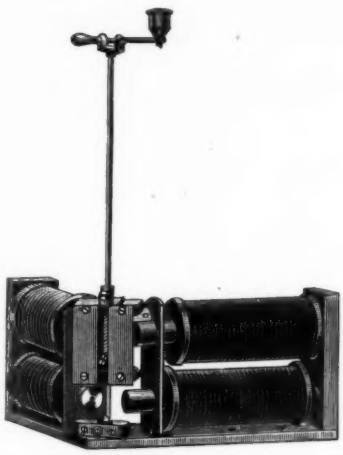

FIG. 2.—RECEIVER.

When the writer pushes the transmitting pen to the right, the pressure upon the right and left pile of carbon discs sends an increased current into the right and left magnets of the receiver, pulling the armature, rod, and the pen the rod carries to the right. When the transmitting pen is pulled down, the increased current sent into the up and down magnets, by the pressure on the carbons, also pulls down the receiving pen. To produce any curved line, the two motions of the transmitting pen, up and down, and right and left, convey corresponding currents to both the up and down and right and left magnets of the receiver, causing the receiving pen, as the resultant of the two motions at right angles, to reproduce the motion that caused them at the transmitting end. Thus is produced a *fac simile* of the hand writing of the operator writing the message, and it will have all the characteristics of his writing.

The operator, in writing, must not move his hand to the right, as is usual. The fingers are to form the letters, while the hand is still, and the strip of paper, moving to the left as fast as a letter is formed, prevents one letter from being made on top of the other. That is all there is to learn, in order to write, and it takes but a few moments of time to learn to write upon the moving strip of paper.

The operator soon finds, also, that it is not necessary to write direct on the paper, with a pen attached to the transmitting stylus. All that is essential is to impart the necessary movement, as in writing, to the stylus, and watch the receiving pen copy it. In a few moments the operator can guide the pen to form any letter he pleases.

The instruments are placed in a case, and are intended to set on brackets fastened to the wall.

The case, made of hard wood, is 14 inches long, 9 inches wide, and 8 inches deep (outside measure). It contains the clockwork for moving the paper, the call bell, transmitter and receiver. On top of the case to the right is the transmitting stylus, to which is attached a pen for writing direct on the paper. The pen in the centre is the receiving pen, attached to the receiving rod, as stated. This pen reproduces any movement of the transmitting pen at the distant station. To the left is the switch for turning the current on the transmitter or receiver as required. Regular fountain pens are used, instead of the style shown in the cut.

Another form dispenses with the pen on the transmitting stylus, and uses the receiving pen for both transmitting and receiving. In this instrument the transmitter is in circuit with the receivers of both instruments, and by watching the pen of the receiver, and letting it form the letters as the operator manipulates the stylus of the transmitter, the most perfect reproductions are made. It takes about 15 minutes longer to learn to operate in this way, but it is so preferable that after a few days, those who write direct on the paper at first, readily change to this latter method in preference, and use only the one pen. The instruments can be adjusted so accurately that it will be impossible, when comparing a message sent with one received, to distinguish the original from the reproduction.

The instruments of the Writing Telegraph Company are said to be remarkably adapted for use in all business houses and manufactories, where the great advantage of written orders or messages is appreciated. Writing telegraph exchanges are projected in all cities and towns of any importance, the subscribers being connected to the central office and writing their messages and answers to each other. The writing has all the characteristics of the writing of the subscriber sending the message, and business men appreciate the record which cannot be disputed, for there is the record at each end, and neither one can be altered without detection.

The instruments are speeded to write 25 words a minute, but as the speed is only limited by the speed of the moving paper, they can be adapted for the most rapid writer. In *noisy* places these instruments are in high estimation. The pen silently writes away regardless of noise of any kind.

It is claimed for the instruments that they are very simple and do not get out of order. There is no battery, except in the central office, and the central office fills and cares for all the fountain pens. The subscriber has no other duty than to wind up the clockwork which moves the paper.

In many ways the writing telegraph instruments appear to have advantages over the telephone, and they are applicable to its commercial uses.

"MAXWELL-JOLIN" PATENT DYNAMO GALVANOMETER.

THE main peculiarity of this new instrument lies in the fact that, whereas in almost all galvanometers there is a fixed coil and a movable magnetic needle, in this galvanometer the coil is movable, and the magnet—no longer a mere needle but a substantial compound horseshoe of steel—is fixed. Fig. 1 represents the instrument itself. A steel magnet is made of three horseshoes, each magnetised as strongly as possible, one of the horseshoes is placed with the poles upwards and two with the poles downwards, overlapping the poles of the one first mentioned, the whole being firmly screwed together and to the base of insulating material. Between the poles hangs the coil, rectangular in form and extremely light, held in its place by a thin silver gilt wire above and another thin silver gilt wire below. The coil is made by winding the wire on a rectangular frame of copper tissue; its weight is only a few grains. To reinforce the magnetic field a compound magnet small enough to lie in the hollow of the suspended rectangular coil without touching it is placed between the poles and is rigidly supported by the magnets

themselves, the poles being arranged N and S. The coil is then free to turn in a very narrow space between the internal magnet and the external magnet poles, and it need hardly be added that this contrivance produces a very intense magnetic field. The current is led in by one of the suspension wires and leaves the coil by the other. So far the arrangement precisely resembles that adopted in the well-known "siphon recorder" of Sir W. Thomson, invented twenty years ago for the purpose of cable signalling. A small mirror is affixed to the suspended coil, a brass spring at the bottom keeps the suspending wires adequately stretched, and a screw-head at the top of the instrument serves both to regulate the tension in the wire and to let the coil down to a position of rest on the central iron cylinder, whenever the galvanometer is to be dismounted for removal to a distant place, and also to adjust the spot of light to zero if required.

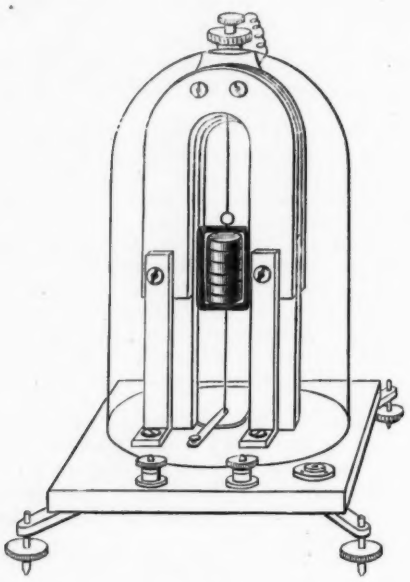

FIG. 1.

The resistance of the coil is about 150 ohms in the ordinary pattern of instrument. As there is no suspended needle no external magnetic force affects the zero of the instrument, and, since the position of the coil is determined solely by the elasticity of the suspending wires and the magnetic action of the fixed magnet on the current of the coil, it can be used in any position, and is independent of the earth's magnetic field. It can even be placed quite near to a dynamo machine. The intensity of the magnetic field in which the coil is situated is such that whenever the galvanometer circuit is closed (even through a considerable resistance) the motion of the needle is dead-beat. It takes less than one second to come to rest at its final position of deflection, and when it returns to zero it does so with the most complete absence of oscillation. The instrument is set with its three levelling screws on a convenient bed. Opposite to it is a semi-transparent scale of glass 50 centimetres in length, graduated in millimetres. The light is provided by a single wax candle held in a holder like a carriage candle, which also carries a mirror back, and has in front a lens in a sliding tube with adjustment carrying a fine-strained wire, the lens focusses the light on to the mirror, which in return throws it on the glass scale. To see the spot of light the observer stations himself in front of the scale so as to see the light coming through the glass. He sees a bright circle having a single sharply-defined black line—the image of the aforesaid wire—down its middle. This patch of light and the central line are perfectly visible in broad daylight, but cannot be well seen by more than one observer at one time.

Another and less expensive form of instrument, called the wall galvanometer, fig. 2, has the horseshoe magnets and centre magnet mounted on a rigid metal plate. The horseshoe magnets are drilled through the neutral point to allow the lower suspension passing through to the spring below, which is supported on the same metal base; the top suspension is carried by a screw head with the same adjustment as in the previous instrument, the lower part of the instrument is enclosed in a mahogany box with a glass front, and the top suspension is protected by a glass tube, the connections being made from one terminal to the top head and suspension, and from the other terminal to the metal plate and spring and lower suspension. A brass plate fixed to the top affords a means of hanging this instrument against the wall, thus economising table space and allowing the fixing of the instrument above the heads of an audience; it also has a strong metal base and three levelling screws, and is fitted with a plumb

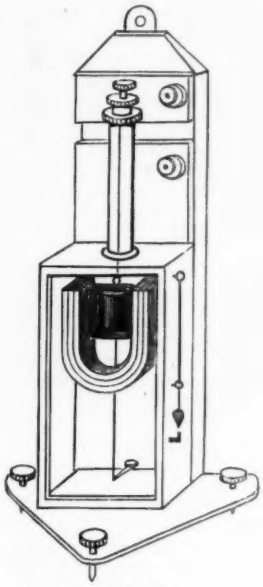

FIG. 2.

as shown, to level it by. These instruments are also constructed to work differentially by winding the coils with two wires and using suitable mercury cups, that will prevent spilling, to make the connections; this form of instrument works most successfully. When set up without any shunt this galvanometer will show a deflection of one millimetre on the scale for about $\frac{1}{1000000000}$th of an ampère of current; but the sensitiveness differs in different instruments with the construction of the coil, the stiffness of the suspension, and the power of the magnets. Two instances of its application may be given.

The instrument can be applied as a voltmeter to measure the electromotive forces of cells in the manner indicated in fig. 3. An ordinary reversing key, K, is connected to the galvanometer, and an adjustable resistance (a Thomson-Jolin rheostat with a thin wire, having a range from 1 to 200 ohms is convenient) is interposed as a shunt, S. To calibrate the instrument a standard Daniell cell (E.M.F. = 1·07 volts) is placed at B in circuit with a resistance box, R. A resistance of 10,000 ohms is unplugged, and a reading is taken of the galvanometer, first to left and then to right, and the shunt resistance is then adjusted until the scale reading is 53·5 millimetres on either side of zero, making a total of 107 millimetres. We then know that a deflection of 1 millimetre right or left will be produced by an electromotive force of $\frac{2}{100}$ths of a volt. The cell whose electromotive force is to be tested is then substituted at B in place of the standard cell, and readings taken right and left; these are added and divided by 100, giving the E.M.F. of the cell directly in volts.

To measure currents the same calibration is made with a standard cell. In the circuit of the current to be measured is interposed a wire, for example, a standard 1 ohm, or for stronger currents 0·1 ohm; the ends of this wire are connected to the key (fig. 3), the 10,000 coil remaining as before. If the current to be measured is 1 ampère, it will on passing through the 1 ohm produce a difference of potential of 1 volt or 50 millimetres, on either side of zero, giving a total of 100 millimetres to correspond with 1 ampère of current. The galvanometer can be easily arranged to measure, on the one hand, millionths of an ampère, or, on the other, thousands of ampères. The instrument is specially

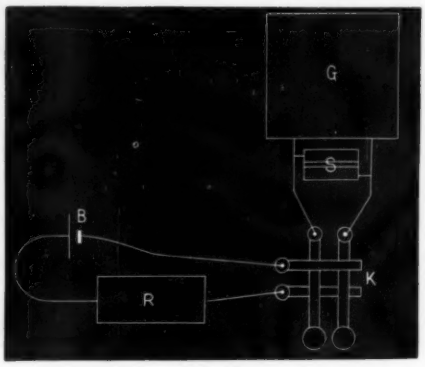

FIG. 3.

valuable for indicating rapid fluctuations of current in experiments on the induction of currents in armature coils when moved in a magnetic field. Its complete aperiodicity and the very small inertia, both mechanical and electrical, of its coil, render it most valuable for such work. The only defect (and that not a very serious one) observed in many months of working is a slight sub-permanent torsion on the suspending wires after taking a large deflection; but the method of taking double readings to right and left eliminates any error that may arise from this cause. These instruments are made by Jolin & Co., of Bristol, who will be pleased to furnish all information.

PRACTICAL NOTES CONCERNING THE CONSTRUCTION, USE AND MANAGEMENT OF STORAGE BATTERIES.

By A. RECKENZAUN.

(*Continued from page* 590, *Vol.* XX.)

Durability of Storage Batteries.—When speaking of the durability of batteries, we have to consider separately the age of positive plates, the age of negative plates and the age of the boxes or receptacles. As regards the latter, we have to take into consideration the kind and quality of the material of which the boxes are made; if these are of toughened glass which is never exposed to extremes of temperature, and if the same are not roughly handled or knocked, then we may assume that such receptacles are everlasting. For stationary purposes glass cells are generally used. In other cases, however, where the batteries have to be moved frequently, or when the same are utilised for locomotive purposes, then glass is not a reliable material and wood or hard rubber is substituted. Wooden boxes are easily attacked and destroyed by the acid, therefore it is customary to line them internally with pure sheet lead carefully burned at the joints. Such boxes are generally made of teak, or other hard wood, which is not liable to warping; when boiled in paraffin wax and pitched inside before the lead lining is fixed, wooden cells will last a long time—several years—if kept dry and clean externally. Sometimes hard rubber or ebonite boxes are used, but these are more expensive and less strong than wooden ones. Boxes have also been made of an alloy of lead of tolerable stiffness, and many other materials have been tried with more or less success. In any case, the durability of such receptacles will be found of minor consequence if compared with the durability of the electrodes. The age of plates is *the* point of vital interest; when we are asked what the life of a storage battery may be, we at once think of the plates and almost ignore everything else; and we feel mostly concerned about the positive plates. We have already explained some of the causes which destroy the positive plates, and we have shown that the *treatment* of secondary batteries has as much to do with their durability as methods of construction or quality of materials. Thick plates, for instance, are found to last longer than thin ones; this is only natural when it is remembered that corrosion takes place upon the metallic support, which wears out in time. This corrosion proceeds mainly from the surface inwards, and the internal parts of a thick plate are protected to a great extent by the mass of superincumbent material. Thick plates offer an advantage if, firstly, the cost of material is much less than the cost of manufacture, and secondly, if weight and space are of little consequence. The cost of material may, however, exceed the cost of labour, and the value of the worn-out material may have a market value not much less than the original metal; under these circumstances it might happen that it is cheaper to renew the plates frequently rather than increase their volume. Weight and space are of the utmost importance in secondary batteries used for electric cars and boats, and in such cases we make the plates as light as compatible with strength of structure, almost irrespective of the cost of labour and the price of lead. Here we have to take into account the energy continually wasted in propelling the battery along with the vehicle it propels, and the point of economy is reached when the depreciation of the battery equals the cost of the motive power which is spent in this auto-propulsion. By decreasing the weight of material we reduce the activity of the plates, or the *rate* at which the current is consumed, and the life of the plates is to a great extent proportional to the amount of work done. In every instance we reach a certain limit which has to be considered with reference to any particular application. If the frequency with which plates have to be renewed is such as to cause little inconvenience, then one stage of the durability difficulty has been overcome. Frequent renewals do not cause a deal of inconvenience when systematically carried out, as would be the case with tramways, but in electric light installations much annoyance is likely to result through such a process, therefore it is advisable on several grounds to produce durable and strong plates for stationary purposes.

Durability versus Waste of Energy.—Let us make a rough calculation to show the relative losses which occur in the case of tramcars propelled by means of storage batteries, leaving out the question of small volume, which is merely a matter of convenience. We assume that the tractive force on a level tram line is 26 lbs. per ton when the car is in motion, and that it takes 100 lbs. per ton to set it in motion; furthermore, that there are some easy gradients and curves which demand a tractive force of, say, 60 lbs. per ton; we may get an average of about 52 lbs. per ton throughout an ordinary track when running at the rate of seven miles an hour. The saving of one ton weight in the shape of secondary batteries would under the above conditions represent a saving of $\frac{5280 \times 7 \times 52}{60 \times 33000} = \cdot 97$ horse-power applied at the driving wheels. If we allow efficiencies of 80 per cent. in the gearing, 80 per cent. in the motor, 75 per cent. in the accumulator and 90 per cent. in the generating dynamo, then we have a total efficiency of about 33 per cent. between the driving wheels and the steam engine; therefore, in order to produce the above tractive force upon the

tram rails we require $\frac{\cdot 97}{\cdot 33} = 2{\cdot}94$, or say 3 horse-power from the prime mover.

The value of a horse-power hour varies considerably according to the price of coal, of labour and especially with the size of the engine, but we may take the cost of a steam horse-power at £12 per annum in large engines, inclusive of all charges, consequently 3 horse-power for, say 15 hours a day, will be worth £36 sterling a year. For this amount of money we can purchase three tons of new lead at the present prices, or we may employ this sum in paying wages for labour. Four-pence per plate, for instance, paid for casting, pasting and fixing may be a fair remuneration, and the amount stated above (£36) would at this rate suffice for the conversion of 2,160 old positive plates into new ones. By saving weight we save power, and the point of economy is reached, as we have hinted before, when the energy wasted in propelling the accumulator of a car equals the cost of replacing worn-out plates. We cannot recover the entire quantity of lead originally put into a plate, although the weight of a worn-out plate is practically the same as that of a new one; there is necessarily some loss in the re-conversion of peroxide and sulphate into metallic lead which may be valued at between 30 and 40 per cent. in money, inclusive of labour and fuel used in the furnaces.

All the above figures are approximate only; the exact values can only be ascertained when all the factors are known, and among the principal factors are firstly, the size and total weight of a car; secondly, the nature of the road and the speed to be applied; thirdly, the number of cars supplied by one charging station, and lastly, the cost of fuel, labour and all necessary materials.

(*To be continued.*)

PRACTICAL ELECTRICAL MEASUREMENT.

By J. SWINBURNE.

(*Continued from page* 56.)

CALIBRATION OF VOLT AND AMMETERS—(*continued*).

Instead of putting the standard cell in shunt to a known and carefully measured resistance, the resistance slide or potentiometer may be used. This consists of a wire of platinum silver, or German silver, or platinoid stretched over a scale of convenient length. Prof. Fleming, who is the great apostle of the potentiometer, prefers a wire having a resistance of about 1 ohm per foot. He also makes the potentiometer double, so that for an 8-feet wire the instrument is a little more than 4 feet long. Platinum silver is here mentioned because there may be some little difficulty in getting either German silver or platinoid wire sufficiently uniform for the purpose. The difficulty of getting wire which is perfectly uniform is one of the chief objections to the use of the potentiometer. Of course the wire may be calibrated, and in any case it must be checked before use; but it would be too tedious to make a scale specially to fit an uneven wire; and it is not likely that any wire will be perfectly even in resistance along its length. Even if it were perfectly even at first, it is apt to be stretched in use, and it may get bent or scraped. The instrument is also cumbersome and inconvenient, as well as inaccurate, and in spite of its being advocated by Prof. Fleming the writer thinks its use should be avoided, the more accurate methods with measured resistances being preferable. For work where great accuracy is not necessary, as in calibrating instruments for commercial use, which need not be within less than, say, $\frac{1}{4}$ per cent., a potentiometer may be used.

Fig. 25 shows an arrangement in which the potentiometer is in series with a set of resistances. D is a set of secondary cells, with switches, M, N, for putting any number in series, L is a set of carefully-measured resistance coils. If the voltmeters to be calibrated run up to 120 volts or so, the resistances, L, should be so high and so well ventilated that they do not get perceptibly hot with 120 volts left on for some time; E is the standard cell, and G the Thomson galvanometer as before. There is a resistance, H, in series with the galvanometer and standard cell. This is short circuited out by closing the switch, F. When the right position for the sliding contact, B, has been found approximately, the switch, F, is closed to make

FIG. 25.

the final adjustment. The resistance of the potentiometer wire, A, K, is first measured. The resistance coils, L, should be made of the same metal or alloy, so as to have the same temperature coefficient; so that there are no errors from differences in the temperature of the room. Before beginning to calibrate an instrument the battery, D, should be tested for leaks to earth. It is certain to have some leak, and one end may be more or less earthed. The pole which has the ground contact must be connected to A, so that the potentiometer may be at the same potential as the earth. The reason for this arrangement is that the potentiometer is apt to leak, as it is difficult to make such an instrument with perfect insulation. Besides the body is at the same potential as the earth, and the various keys and contacts in connection with the potentiometer may be imperfectly insulated from the observer when in use.

If instead of switching the cells in and out, so as to get the desired electromotive force, resistance switches are used, they must not be put between D and A, as when low electromotive forces are required the potential of the potentiometer would differ from that of the earth by that lost in the resistance. The resistances should, therefore, be between D and C. The resistances themselves may be badly insulated from the earth, and in that case it is best to make a good contact between the earth and the pole of the battery which is connected to A. Any small leak in the resistance coils then causes local earth currents only, and does not cause any difference of potential between the potentiometer and the earth or body. It may often be advisable to earth one pole of the cells as shown. The question of leaks has been discussed at some length, because it is only by very careful attention to details, apparently so small, that accurate work can be done. Slight leaks are a great source of inaccuracy in calibration. Small errors are sometimes ascribed to thermo-electromotive force due to the contacts of the potentiometer, but these errors are no doubt due to leaks, to changes of specific resistance by heating, or to cells running down, as the contact forces are far too small to produce such effects.

To calibrate a voltmeter it is put in shunt to the resistances, K, and to the potentiometer, as shown. Any electromotive force near the lowest reading required is then put on, and the sliding contact, B, is moved till there is no deflection when it is touched down. More accurate adjustment is then made with the switch, F, closed. If B does not come in a convenient part of the

scale of the potentiometer, the resistance, L, is altered and a new adjustment is made. The distance from A to B is then read off on the scale, and as the resistance of the wire, A K, is known, the resistance of A B, is known. It is then compared with the resistance between A and C, and the electromotive force on V is thus obtained; as the resistance A B : A C :: 1·435 : electromotive force on V, E being here supposed to be the electromotive force of a Clark cell, and the electromotive force measured in legal volts. Another cell is then put in circuit and the process repeated. The resistances, L, should be adjusted so that the contact, B, is not moved very much; if the resistances, L, were arranged so that with 10 volts B came close to K and were left so till there were 100 volts on V, B would be moved $\frac{9}{10}$ths of the way to A, and any unevenness in the wire would cause errors to creep in. This arrangement is not direct reading, so that there is waste of time in using it.

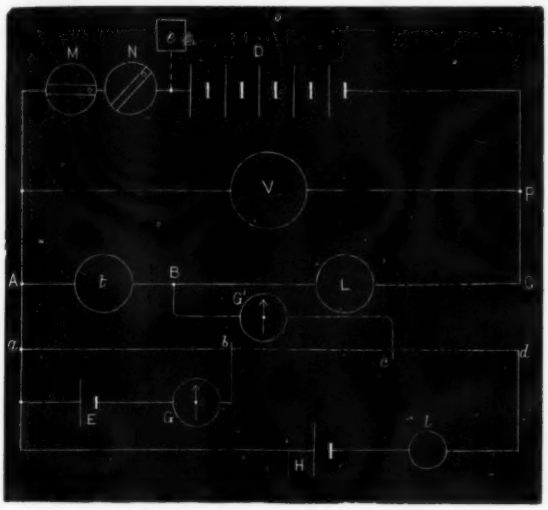

FIG. 26.

The potentiometer may be arranged as a local circuit with its current supplied by a local cell or battery. Fig 26 shows an arrangement with a local potentiometer circuit. The cells, D, may be insulated with great care, but it is probably best to consider a leak inevitable, and to earth one end of the battery as shown by the earth plate. V is the voltmeter which is being calibrated. t and L are high resistances capable of taking the highest electromotive forces required. t is much less than L, so that there is a fall of one or two volts only over it. a, d, is the potentiometer wire, and H is a secondary cell supplying it. l is a rheostat or adjustable resistance. This is for adjusting the current in the wire and keeping it constant. Keeping the current constant by adjustment saves calculation, but is not necessary. Besides, a large cell does not run down appreciably.

E is the standard cell, and G a galvanometer in series with it. Another lead is taken from B, through the galvanometer G′ to c'. The potentiometer then compares the fall of potential over a, b, with that over a, c. The electromotive force on one voltmeter is thus $1{\cdot}435 \frac{a\,c}{a\,b} \times \frac{\mathrm{L} + t}{t}$. This diagram is taken from Prof. Fleming's article in *Industries*, of March 4th, 1887; but the disposition is altered, as in Prof. Fleming's arrangement the galvanometer is so connected that the least leak throws the whole of the measurements wrong. Prof. Fleming's arrangement depends for its success on the perfect insulation of all the parts of the apparatus, and he insulates himself with paraffin to work with it. There is no real advantage in putting the potentiometer in a separate circuit, as the sensitiveness is not perceptibly increased. On the other hand, it is more costly and more complicated. The contact springs at b and c should have ebonite press buttons, as the finger will be at a higher or lower potential of a volt or two. Of course G and G′ are the same galvanometer. The connections may be led to mercury cups in a block of paraffin. Blocks of paraffin, though they look untidy, and are not often used, are very handy, as the insulation is so perfect, and if they get dirty a little of the outside can be pared off.

The arrangements which involve the use of a potentiometer have been described here because Prof. Fleming, who has given considerable attention to the subject, advocates its use; but it would seem much simpler and much more accurate to remove the whole of the arrangements forming the lower part of fig. 26, and to put a standard cell with key and galvanometer in shunt to t, so that the arrangement becomes as described in the last article. The electromotive force on the voltmeter is then got volt by volt, which is an advantage. An adjustable resistance must be put in circuit between D and P. The resistances, L, may be made up in the ordinary way, but the wire should not be wound double, as self-induction gives no trouble when cells are used and insulation is important. It is important that the coils should keep cool. Mr. Ashley, the head of Messrs. Crompton & Co.'s instrument department, uses a number of coils wound on ebonite bobbins with a pair of copper terminals sticking out at one end. A block of solid paraffin is made with hollows which serve for mercury cups. The coils are placed on the block of wax so that the terminals of each dip into neighbouring cups, and when a coil is removed it is replaced by a short-circuiting loop of stout bent wire. The coils consist of 20 bobbins of 1,000 ohms each. If the instrument to be calibrated contains iron it must be calibrated upwards, as persistent magnetism errors would otherwise throw the readings out. This makes it difficult to arrange the resistances, L, so as to avoid temperature errors. If the high readings are taken first, the resistance coils may all be allowed to get as hot as they will first, and as the current through the resistances is practically constant, no error will creep in as the coils are merely put out of circuit one after the other. In calibrating upwards, however, cold coils have to be added successively. The best method is to make the resistances high and ventilate the coils. Of course no errors arise from the temperature of the room, as the ratio of t to L remains constant. When t is a fixed resistance, and L a set of coils, the temperature error due to the variation of electromotive force of the standard cell makes a correction for temperature necessary. This difficulty may be overcome in several ways. A small stretched wire may be inserted between t and L, so that by moving the contact, B, along it, the temperature error may be almost exactly corrected. This wire resistance is so small in comparison with t that any unevenness in the wire causes no perceptible error. Perhaps the best way is to wind the coils of L with wire with a higher temperature coefficient than that used in t. Thus each of the coils of L may be partly of German silver and partly of copper, while t is entirely German silver. The amount of copper used depends on the temperature coefficient of the particular sample of German silver used. This does not give a solution of the problem mathematically correct, but for practical work it is near enough, as it is within one in two thousand when an instrument is calibrated from 100 volts down to 10. The arrangement is thus direct reading, a point of great importance in practical work.

If the arrangement in fig. 26 is used, it can be made direct reading by putting b on the mark 1435 or some simple multiple of it, so that c reads the electromotive force on the voltmeter. If L is not 99 t, of course another figure must be used to make the potentiometer direct reading.

(To be continued.)

Lighting in Mauritius.—The Town Corporation of Port Louis, Mauritius, intimates that the contract for lighting the town comes to an end in October, 1890, and that the town clerk is ready to give information to intending contractors concerning the new contract.

O

THE VICTOR TURBINE.

SOME new forms of this turbine, which have just been introduced, will probably be in demand as motors for electric lighting machinery where a fall of water is available. Fig. 1 represents a single Victor turbine on horizontal shaft, with flume, driving pulley, and outer bearing, all placed upon a cast iron bed-plate in the most complete and substantial manner, ready to attach the supply pipe and draft tube. In the engraving the supply pipe is designed to be attached to one end of the flume, but it can be arranged to attach to either side of the flume if preferred, closing the end with an iron head. A governor for regulating the speed of the wheel is shown mounted on the top of the flume, and is recommended as a most complete and satisfactory arrangement.

Fig. 2 is a 5-inch Victor turbine on horizontal shaft with flume, designed to meet the demand for a small turbine adapted to high falls and light streams. The wheel is made of gun metal, the shaft of steel, the flume of cast iron, the bearings of best anti-friction metal, the whole being of the most simple and substantial character. A valve in the supply pipe is used for regulating the supply of water instead of the regular register gate, owing to the great pressure incident to high falls. The engraving represents the wheel and flume complete, ready to attach the supply and discharge pipes, which are both 5 inches in diameter.

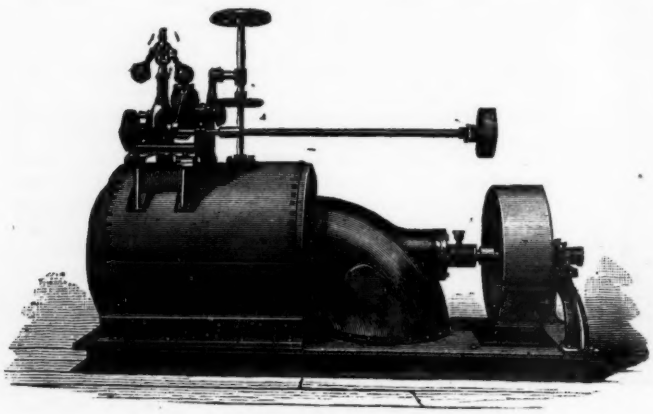

FIG. 1.

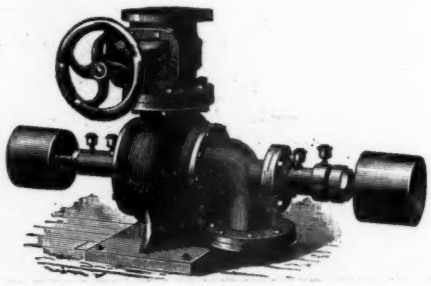

FIG. 2.

HINTS ON THE ELECTRIC LIGHTING OF SHIPS.*

THE electric lighting of ships is now becoming common, at least on passenger ships, where a good light is considered as part of its comforts, and the old method of oil lighting is gradually dying out. But, however common it may be, I venture to think it is far from being perfect, at least from a practical working point of view. Every electrical engineer knows the desirability of having the dynamo and all around it kept dry; but how many of them know the state of the dynamo-room at sea, assuming that the dynamos are in the same room as the main engines, as is generally the case. In some cases the dynamos are placed on a level with the bottom platform of the engine-room, and all the water that the engines throw off runs straight into the dynamo-room; and it does not matter whether it be salt or water of condensation, it is destructive to the insulation of the machines, and also destructive to the driving ropes, if any be used; and if leather belting be employed it causes them to slip, which in electric lighting is a great objection. Besides, when there is about 3 inches of oil and water rolling about from one side to the other, it is anything but a pleasure to the electrician in charge.

To prevent all this, the dryest place in the ship, consistent with its position with respect to the boilers and the saloons, ought to be chosen as the dynamo-room; and the choice ought to be left to a person who has sailed in that particular ship, or if that ship has not sailed before, to a suitable authority. In some cases the machines are placed on a level with the middle platform. When such is the case it is a little better, but not much; it is exposed to water, but not to the same extent as before. For instance, I know of a case where the iron deck directly above the machines was leaking through one of the bolts—a very common occurrence in these iron decks—and the salt water was dripping very slowly, and unknown to anyone, on to the field magnets of the machine, it soaked its way through the insulation to the wire, and also down to the core of the field magnets. One night, whilst the machine was running, I observed a stream of blue light suddenly thrown out from the field magnets. I stopped the machine and tested if the insulation was good. I found it was all right, but could not fathom this mystery, for I had never seen anything of the sort before. After a while I re-started the machine, and it worked all right. I could not detect anything faulty whatever about it. Two nights afterwards, before morning, I was aroused with the news that the machine had been "running away," but they had stopped it, and went down and found that the armature was burnt. I tested the machine for the cause, and found this time that the field-magnet wires were short circuited with the core in two of the coils. Whilst I was leaning over the machine a drop of water fell on my neck from above. I looked up, and found a wet place around a bolt. After waiting two or three minutes, another drop came and fell directly on to the end of the field magnet, where the wire comes out of the brass end, and into the hole it went and down amongst the wire. This leakage was only in rough weather. I unwound this magnet, and found that the wire at the ends of all the layers next to the brass ends was actually bare for about two inches in length, probably caused by the salt water, or the salt being thrown out in a state of fusion. Here is a necessity for having the machine magnets covered.

Now the next point that ought to have a little consideration is the "return" wire. In some ships, where the E.M.F. does not reach as high as 100 or 110 volts, the iron of the ship is used as the return. Now I do not think that this method is advisable with such an E.M.F., although I have never heard of any serious accidents occurring with an E.M.F. of 110 volts, yet I believe that such an E.M.F. can prove dangerous under certain conditions. In an installation where the E.M.F. has been only 50 volts, I have experienced very severe shocks, where the iron of the ship has been used as the "return," and with an alternating current. I know of an instance of a fireman who was cleaning up the floor of the dynamo-room, and he, like everyone on watch in the engine-room, was perspiring from the excessive heat from head to foot, and his boots were also wet. He rubbed against the positive terminal of the machine with his trousers; the man yelled out and was soon laid on the floor. He did not get up for a few minutes. He turned very pale when I held him up, and he walked right out of the place trembling. The pressure in this instance was only 50 volts. Another shock that I experienced myself was quite sufficient for me at the time. I was overhauling one machine and testing the different parts of it with the full current from the other machine, a positive wire was dangling overhead, which was being used for testing. I accidentally touched this wire with my eyebrow, or just about my left temple, and it sent a shock like a flash of lightning through my brain, and I was unable to see for a full minute after. This was again only 50 volts. Therefore, I think I have good reasons for thinking that a current of 110 volts might prove dangerous under certain conditions. Electrical engineers never consider this. They judge of the "shocking" strength of the current from its effects ashore, when everything is in a dry condition, and never think that greater facilities are offered for a good contact, when the person is soaking wet from head to foot. 50 volts can hardly be felt with the fingers when everything is dry, and 110 volts gives only a slight burning sensation. But what would it give under the conditions I have named? As the result of my experience I am of opinion that electrical engineers ought to incur the extra cost of running a special return wire when currents above 50 or 60 volts are to be employed. Of course, 10 or 20 volts of a margin may be allowed for continuous currents, which are far from being so dangerous as alternating currents.

* *The Mechanical World.*

ELECTRIC LIGHTING IN GLASGOW.

AT a meeting of the Glasgow Town Council Bazaar Committee a report on the lighting of the City Hall, Bazaar, and Municipal Buildings was submitted by Mr. W. A. Bryson. After deliberation it was unanimously agreed to recommend that the new Municipal Buildings should be lighted entirely independently of the Bazaar and City Hall. Mr. Bryson recommended that the City Hall and Bazaar should be lighted by two circuits—on the series system—of 13 15-arc lamps on each, driven by two small engines. He estimated the cost of generating plant for the Bazaar and City Hall at £1,800. The meeting was of opinion that the engines and boilers should not be placed under the Bazaar, but that a site should be got for them as nearly adjacent thereto as possible. As regards the Municipal Buildings, Mr. Bryson assumed in his report that the power required was to be obtained from engines and boilers placed either at the Bazaar or some other place away from the buildings, and recommended that the arc system should, to a large extent, be adopted, except in the smaller rooms and corridors, where incandescent lamps would be necessary. The meeting was of opinion that the incandescent system of lighting should be adopted, except as regards the quadrangle, and that an endeavour should be made to obtain the necessary accommodation for the engines and boilers on property adjacent to the buildings. At a subsequent meeting the committee resolved to recommend that the above minute be approved of generally so far as relating to the Bazaar and the City Hall, and that the matter be remitted back to them, with power to take such further action as they might consider expedient.

Bailie CAMPBELL moved the approval of the minutes.

Mr. SIMONS said that when they contemplated lighting the Bazaar and City Hall with electric light it was their belief that they would be able to supply the Municipal Buildings as well as the Bazaar and City Hall from plant situate under a portion of the Bazaar. It had been shown that that could not possibly be done, and that if they wanted to light the Bazaar just now as well as the City Hall it would be necessary to expend about £2,000 on plant, as well as to acquire a site for the erection of that plant, and to uphold a staff of engineers to superintend the whole business. It must be evident that under these altered conditions it would be a mistake to proceed with such a large expenditure, considering what was to be obtained. He suggested that Bailie Campbell should enlighten them a little on the matter.

Bailie CAMPBELL said he understood the Council had already powers to go on with the electric lighting.

The DEPUTY TOWN CLERK said he thought the joint committees were to consider the whole question of the lighting of the Bazaar and the Hall. They came up now, and made recommendations that tenders should be got, and the matter remitted back to them with powers.

Mr. DICKSON thought it was a pity they should go to the expense of fitting up the electric light without some expression from the Council as to its advisability. Gas lighting had now been improved so much that he thought it might very properly be considered before any decision was arrived at. To expend £2,000 on electric lighting plant was a step which he felt strongly ought not to be taken in the meantime.

Mr. URE also urged that the committee should not jump to any hasty conclusions in this matter. They might consider whether it would not be advisable to adopt some of those regenerative burners, which as well as lighting economically acted also as ventilators.

The committee agreed to take the matter back for reconsideration.

THE SCIENCE AND ART EXAMINATIONS.

MAGNETISM AND ELECTRICITY.

Examiners, Professor G. CAREY FOSTER, F.R.S., and Professor A. W. RUCKER, F.R.S.

Magnetism.

1. A small magnet is placed upon a flat cork which floats in a basin of water, and it is fastened to the cork with a little wax. Describe and explain the behaviour of the magnet (1) when under the influence of the earth's magnetism alone, (2) when an artificial steel magnet is brought near to it.

2. A compass needle and a straight strip of soft iron of the same length as the compass needle are fastened together so as to be in contact with each other at both ends. Will the force which tends to make the combination point north and south be the same as that which would act on the compass needle alone? Give reasons for your answer.

3. How would you construct an astatic needle out of a uniformly magnetised strip of watch spring, which you are allowed to bend or break as you please?

[The arrangement of magnets here referred to is generally known as an "astatic pair" or an astatic combination. Never as an "astatic needle."—EDS. ELEC. REV.]

4. If a compass were carried round the equator, would it point in the same direction at all places? If not state, as nearly as you can, what changes would be observed in its behaviour during the journey.

Frictional Electricity.

5. A pith ball is suspended from a metal stand by a fine thread. If you have a strongly-electrified glass rod, how can you find out whether the thread is a conductor or a non-conductor of electricity?

6. If you were given a negatively-electrified stick of sealing wax and two metal balls mounted on insulating supports, how would you, with this apparatus, charge the balls with opposite kinds of electricity? How could you afterwards find out whether you had charged the balls as you intended, and whether their charges were equal or unequal?

7. An insulated conductor, A, is brought near to the cap of a gold leaf electroscope which has been charged positively. State and explain what will happen (1) if A is unelectrified; (2) if it is charged positively; (3) if it is charged negatively.

8. Describe any experiment by which you could prove that when electrification of one kind is produced, the opposite kind is also produced in equal quantity.

9. An orange, into which a sewing needle has been stuck, point outwards, is suspended by a dry silk thread. A charged body is brought near to it, 1st, opposite the point of the needle; 2nd, opposite the side remote from the needle. State and explain the electrical effect in each case.

Voltaic Electricity.

10. Describe and explain any workable experiment to prove that the terminals of a galvanic battery differ electrically in the same way as the conductors and rubber of an electrical machine at work, but to a less extent.

11. The platinum and copper plates of a Grove's and a Daniell's cell are connected by a wire. Would there be a current if the zinc plates were also connected, and if so in which direction would it flow?

What reason have you for your answer?

[This question is rather unpractical and scarcely fair under the *present* elementary syllabus of the Science and Art Department.—EDS. ELEC. REV.]

12. The current from a voltaic battery is passed at the same time through a thin wire and through dilute sulphuric acid, connected in series. What will happen to the wire and to the dilute acid; and what change (if any) will be produced in each case by reversing the battery connections, so as to alter the direction of the current through the wire and liquid?

13. Two compass needles are arranged near each other so that both point along the same straight line. A wire connecting the platinum and zinc ends of a battery is stretched vertically half way between the needles. How will the current in the wire affect the needles, and how will the result depend upon whether the platinum terminal is connected with the upper or lower end of the wire respectively?

14. If you were given any galvanic cell you chose, wire with an insulating covering, and a bar of soft iron, one end of which was marked, state exactly what arrangements you would make in order to magnetise the iron so that the marked end might be a north-seeking pole? Give a diagram.

SECOND STAGE OR ADVANCED EXAMINATION.

Magnetism.

21. What effect (if any) is produced (1) on the weight, (2) on the position of the centre of gravity, of a piece of steel by magnetising it? Give reasons for your answer.

22. Two long magnets are placed vertically with their north poles (A and B) at the same level as the north pole (C) of a compass needle, one being magnetic east and the other magnetic west of C. If the compass is not deflected when the distance A C is twice B C, and if all the magnets are so long that the effects of their south poles may be neglected, show what are the relative strengths of the poles, A and B.

23. A compass needle is suspended at the centre of a circle drawn on a horizontal table. A magnet is moved round the compass so that its centre always lies on this circle, and that its length always points magnetic east and west. How and why will the position of the compass needle change as the magnet is carried round it?

24. Two magnets, A and B, are in turn suspended horizontally by a vertical wire so as to hang in the magnetic meridian. To deflect the magnet, A, through 45°, the upper end of the wire has to be turned once round. To deflect B through the same angle it has to be turned round one and a half times. Compare the moments of the two magnets.

Frictional Electricity.

25. Describe and explain the construction and action of the essential parts of Sir W. Thomson's quadrant electrometer.

[To answer this question properly with the necessary sketches requires more knowledge than is expected from the Science and Arts Department's advanced syllabus.—EDS. ELEC. REV.]

26. Two insulated metallic plates are placed facing each other, and each of them is connected with a separate gold leaf electroscope. If one plate is charged, the leaves of both electroscopes diverge. If now an unelectrified slab of sulphur is introduced between the plates without touching either, state and explain the effect on each electroscope.

27. A metal ball, A, is placed at a distance of 1 foot from an electrified ball, B. It is then connected for a moment with the earth. If the ball, A, is now placed 2 feet from B, and again connected with the earth, compare the charges acquired by A in the

two cases and explain the results, assuming that, in each case, the charges of both A and B are uniformly distributed over them.

28. An electrical machine is placed in an insulated chamber which is lined inside with tinfoil. The rubber of the machine is connected with the tinfoil. What will be the effect upon an electroscope placed outside and connected with the chamber when the machine is in action? Explain your answer.

29. How would you arrange an experiment to deflect the needle of a galvanometer by a current produced by a frictional electrical machine? Would it be necessary, in such an experiment, to insulate the wires connecting the galvanometer with the electrical machine more carefully than if a galvanic cell were used in place of the machine? Give reasons for your answer.

Voltaic Electricity.

30. When a coil of wire is connected in circuit with a battery and a tangent-galvanometer, the galvanometer shows a deflection of 45°. If the wire is replaced by resistances of 24 and 25 ohms in turn, the deflection is 46° in the first case and 44° in the second. Find the resistance of the wire. Tan 44° = 0·966; tan 45° = 1·000; tan 46° = 1·036.

31. A current is passed through a coil of wire and through a voltameter arranged in series with it. If the strength of the current is altered so that the heat produced per minute in the coil of wire is doubled, show what change will be produced in the rate at which chemical action takes place in the voltameter.

32. If an increase of the resistance of a circuit by 10 ohms causes the strength of the current to decrease from 5 to 2, find the total resistance of the circuit after the change.

33. Two bars of bismuth, A and B, are attached to the extremities of a bar of antimony, and a current is passed from A to B. Is there any difference, and if so what, between the effects produced at the two junctions? How does the effect in each case depend on the strength of the current?

34. A piece of wire is bent into the form of a rectangle, and the ends are joined. It is laid upon a horizontal table with two sides pointing magnetic north and south. If the rectangle be turned about the east side as a hinge so as to lie on the table to the east instead of to the west of it, what will be the direction of the current which circulates in the wire during its motion, in consequence of the earth's magnetism?

HONOURS EXAMINATION.

41. Describe the apparatus and operations necessary for the determination of the mechanical equivalent of heat, by means of observations on the heat developed in a wire when an electric current is passed through it.

42. How would you determine the value of an unknown resistance if you were supplied with a battery, a Thomson's quadrant electrometer, and any wires, keys, or resistance boxes you might require? If the electrometer were not fitted with a replenisher and gauge, how would you guard against errors due to a loss of charge by the electrometer during the experiment?

43. Explain exactly how you would determine experimentally in absolute measure the electromotive force of a constant cell.

44. Two metal balls, supported by insulating stems at a small fixed distance apart, are electrified so as to attract each other with force, *f*. If now the balls are immersed in bi-sulphide of carbon (specific inductive capacity = 2), show what force they will exert on each other:—(1.) If their respective charges remain the same as when they were surrounded by air. (2.) If the difference of their potentials is the same as when they were in air.

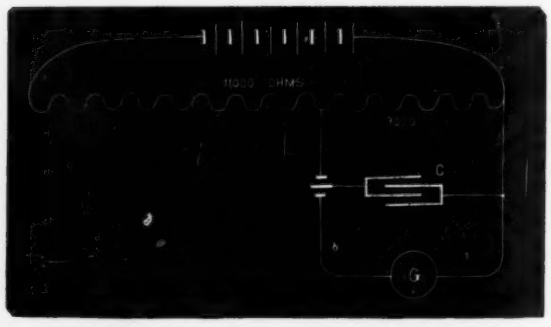

FIG. 1.

45. In an experiment for the determination of the capacity of a condenser by the ballistic-galvanometer method, connections were made as follows:—The current from a battery of Leclanché cells was allowed to pass continuously through a set of coils of total resistance 11,000 ohms. Then (fig. 1) the condenser (C) to be measured was charged by joining its coatings one to each of two points in the circuit separated by an intervening resistance of 3,000 ohms; after which it was discharged through the ballistic-galvanometer (G), and the throw was read by the motion of a spot of light on a straight graduated scale: mean reading, 64·2 scale-divisions.

Next (fig. 2) the condenser was removed, and the galvanometer was joined in multiple arc with a coil of 200 ohms forming part of the battery circuit, the resistance of the galvanometer branch being made up to 20,123 ohms. The galvanometer thus showed a permanent deflection of 58·44 scale divisions.

FIG. 2.

Time of one complete vibration of galvanometer needle = 8·452 sec.

Determination of Damping.—The galvanometer needle having been set vibrating, the first elongation observed was 104 scale divisions, and the twenty-fourth elongation was 45·5 scale divisions.

$$\frac{1}{23} \cdot \log. \frac{104}{45{\cdot}5} = \log. 1{\cdot}0366.$$

Distance from galvanometer mirror to centre of scale = 85·75 cm. 300 scale divisions = 19·04 cm.

The deflections are so small that they may be identified with their *sines* or *tangents* without sensible error.

Calculate, from the above data, the capacity of the condenser.

[This question is not very clearly or neatly put.—EDS. ELEC. REV.]

Next week we shall, space permitting, print the City and Guilds of London Institute's Electrical Engineering Examination Questions.

THE STOCKHOLM GENERAL TELEPHONE COMPANY.

OF the great inventions of the present century there is hardly any which has been turned to advantage so rapidly and completely in Sweden as the telephone. On February 14th, 1876, Mr. Graham Bell, the American inventor, presented his petition to the Patent Office at Washington for patenting the telephone, and so soon as the following June Herr H. T. Cedergren, a Swedish engineer, laid a telephone line in Stockholm between two houses in the Drottninggata, and now, ten years after, there are in operation in Sweden over 14,000 telephones, of which number 5,500 are in use in Stockholm alone.

The first impetus to the more general use of the telephone in Stockholm was given by the Stockholm Bell Telephone Company in 1880, which in September of that year opened the first telephone net, embracing some 120 lines. The subscription fees of this company were, however, so high, according to Swedish notions, that the bulk of the public was debarred from profiting by the use of the new invention, and as the telephone can only be said to be of real value when it is found in nearly every house—a result which can only be effected with a moderate subscription fee, a fee lower than that at first charged by the Bell Company—a proposal was made by the Association of Houseowners of Stockholm to the directorate of the Bell Company to lower their fees. As, however, the company did not see its way to comply with this request, Herr Cedergren, on February 19th, 1883, issued a prospectus inviting the formation of another company, which should offer the use of the telephone to the public at a lower rate, and which should also be so constituted that the shareholders should let the subscribers benefit when a certain reasonable dividend had been obtained. Herr Cedergren further proposed that in order to make the introduction of the telephone general, those private houses where it was not used so much as in houses of business should be provided with an automatic shunting apparatus (an invention of this gentleman, together with Herr L. M. Ericsson, an engineer now well known in Sweden for his manufacture of telephonic apparatus), which enables residents in any part to communicate direct with the central station, although only one single wire from the shunt to the station, and a place at the shunting table, is required for the use of all.

This invitation to form a new company was so eagerly accepted by the public, that on March 30th the company received its concession by Royal resolution. It was named the Stockholm

Allmänna Telefon Aktiebolag (the Stockholm General Telephone Company), its managing director being Herr Cedergren.

Immediately after the formation of the company, the fixing of the telephone plant began, and it should be mentioned that all the apparatus, &c., used for the same have always been of Swedish manufacture, made by Messrs. L. M. Ericsson & Co., of Stockholm, whose articles have been found to surpass similar ones made abroad.

In consequence of the situation of Stockholm, the company decided at first upon establishing three stations, viz., one for the suburbs of Norrmalm, Ostermalm, and Kungsholmen, one for the city proper, within the bridges, and one for the suburb of Södermalm, and on July 11th, 1883, the company's central station at Norrmalm was opened for service telephoning, and on the following October 31st to the public, 332 telephone lines being then open for use. On December 1st the station at Södermalm was opened, but the station within the bridges could not be opened till the following March, in consequence of delay in delivery of some wire required for the wire poles.

At the end of 1883, 1,160 subscribers were registered and 785 telephone lines completed, and since then the number of the former has steadily increased as follows :—

December 31st,	1883	1,160
„ „	1884	2,288
„ „	1885	3,164
„ „	1886	3,600
July 12th,	1887	3,786

Besides this the State telegraphs have since March 1st, 1883, been connected with the telephone net of this company.

As will therefore be seen, the number of the company's subscribers has grown very rapidly, and although the first stations were opened with a view to future enlargement, it was soon found that they were too small for the work required. Besides, by the system adopted by the company in establishing their stations, only a limited number of wires could be introduced to a station, whilst for connecting these, which led to two different tables, the services of both assistants at these tables were required.

Although in the spring of 1884 the company's stations were only just opened, it was of great importance to the development of the telephone in Stockholm that an invention was made in America at that period of a new system of shunting tables for telephone stations. The multiple switchboards are so constructed that all wires at a station pass through all the tables in use, whereby each assistant may, without aid, connect those wires running direct to his table with any other in the station.

This invention promised the possibility of dispatching at a station with quickness and accuracy several times as many messages as before, and the company did not hesitate to adopt it. Already in the summer of 1884 multiple tables were fixed experimentally at the stations in the city and at Södermalm, manufactured by Messrs. Ericsson, and as the experiments at once demonstrated the superiority of the same over the old ones, the company decided on fitting one station entirely with these tables and on getting thither as many telephone lines as possible.

As, however, none of the existing stations possessed space enough to accommodate them, the company was compelled to seek other accommodation; and as the quantity of wires to be gathered at one spot required special arrangements, it was decided to erect an entirely new building.

For this purpose a site was purchased in a most eligible locality, plans drawn for the new building by the engineer's department of the company, whilst the exterior of the building was designed by Prof. Isæus and Herr W. Klemming.

Ever since the first work on the building was begun, experiments have been made for the purpose of ascertaining what conductors were most suitable for the telephoning. As, however, it was evident from the beginning that the results of these experiments could not be calculated, it was decided to take such measures for the solidity of the foundations of the building that a large complement of wires might be fixed with safety on it, and this precaution proved fully justified. It was found easy to surmount the drawback caused by induction between the conductors in old tables, but in its place another problem arose to be dealt with in the new one, viz., the retardation of the current.

The company was in consequence compelled to return to the original plan of fixing large numbers of wires on the building, which are, however, situated lower than was at first contemplated; and in order to secure these safely it was necessary to run thick iron stays in various directions through the building, even down to the ground, where they were affixed to thick iron plates. This necessity has, no doubt, to some extent interfered with the most advantageous arrangements of the building.

On the Stockholm Board of House Building having approved the drawings for the new building, the work of erecting the same was at once begun, but in consequence of the peculiar arrangements of the offices, and the necessity of their being turned to the best advantage, it has taken longer than was anticipated. In spite of this, the reserve materials, &c., of the company could already, on April 1st, 1886, be removed to the new building, and in December last the offices of the company were opened there. After the introduction of the multiple tables in October, 1886, the former station at Norrmalm was closed, in May, 1887, whilst the new station was formally opened on July 12th, last.

The new telephone building, or as it has justly been called, telephone palace, contains in the part facing the street Smedjegatau two storeys which, together with the vaults in the same, are used for store rooms and workshop. The upper one of the two storeys extends, also, under that portion of the house which faces Malmskiluadsgatau, another street, and in this is placed the boiler for heating the building, and the machinery for its lighting by electricity. On the first floor are the offices of the board, the manager, and engineer, whilst those portions of the building not utilised will be let off. On the second floor is the great operating hall, 115 feet in length, 30 feet in width, and 25 feet in height, occupying the whole breadth of the building between the two streets. There are also the necessary refreshment-rooms, lavatories, laboratory, &c. The whole of the building being heated by means of a kind of hot-water stove, constructed by Herr O. E. Westin.

The operating hall, calculated for 7,000 wires, contains 24 multiple tables, manufactured by Messrs. Ericsson & Co., and although with the tables now in readiness—viz., 20—only 4,000 are connected, this station is still the largest of the kind in existence. The length of the wires within it alone is 380 miles, whilst they are soldered to no less than 265,000 places in the tables.

Under the old arrangement of stations with multiple tables the connection between the tables has been effected by means of cables, but as these possess more or less the disadvantages referred to, and are besides liable to stretching of the conductors within, close wires have been adopted instead, woven together into nets, for this purpose. This charge was adopted on the recommendation of the company's engineer, Herr A. Aven.

The development of the company has, as stated, progressed very rapidly, the number of messages transmitted since the opening of the northern station—October 31st, 1883, till July 12th, 1887—being as follows :—

In 1884	2,332,082 messages.
„ 1885	4,772,760 „
„ 1886	5,802,063 „

It will thus be seen that the number of messages has doubled in two years.

The average number of messages per day was :—

In 1884	7,291.
„ 1885	14,995.
„ 1886	18,222.

The average daily "calls" made by the subscribers were :—

In 1884	4·0 times.
„ 1885	5·39 „
„ 1886	5·46 „

In the company's service there were in 1883, 23 assistants; in 1884, 63; in 1885, 83; and in 1886, 104. Whilst the length of the telephone net was as follows :—1883, 1,628 kilometres; 1884, 3,262; 1885, 4,249; 1886, 5,287.

Besides the telephone net of the company now extending to towns some 50 miles south and north of Stockholm, it has arranged and is working the telephone system in the town of Söderhaum, on the Baltic.

Finally, it may be of interest to compare the extension of the telephone in Stockholm with that of other cities, according to statistics furnished by the "Bulletin International de l'électricité" for the year 1885 :—

City.	Number of inhabitants.	Subscribers.	
		Number.	Per 1000 individuals.
Stockholm	215,000	4,832	22·5
Helsingfors	46,000	575	12·5
Rome	300,000	2,054	6·4
Copenhagen	274,000	1,336	4·9
Amsterdam	335,000	1,195	3·6
Berlin	1,280,000	4,248	3·3
Brussels	380,000	803	2·1
Paris	2,800,000	4,054	1·4
St. Petersburg	850,000	1,100	1·3
London	4,765,000	4,193	0·9
Vienna	1,200,000	946	0·8
Madrid	477,500	270	0·6

As already mentioned, the number of subscribers in Stockholm has now increased to 5,500.

The Carpenter Electro-Air Brake.—It is stated that the Westinghouse Air Brake Company and George Westinghouse, jun., have begun suits against Mr. F. Carpenter, the inventor of the Carpenter air-brake, for infringement of the Westinghouse patents. The complaint charges that the Carpenter brake, as exhibited at Burlington, is an infringement in several points, the chief ones being the couplings, the brake valve, the train-pipe, and the brake cylinder. Mr. Carpenter claims that he has a full defence. The case will be heard by the United States Circuit Court at Keokuk, Ia., at the July term.

FINSBURY TECHNICAL COLLEGE.

THE gala day of the year for the students at Finsbury arrived on Friday, last week, when they showed how well they know the way to please and be pleased. The College in Leonard Street never presented a more attractive appearance. From the entrance hall to the topmost floor every possible spot had been adorned either florally, by illumination, or with bunting. A blaze of light from a suspended arc greeted the visitor at the moment of entering, and when inside the softer beauties of the incandescent lamp won his warmer admiration. An illuminated fountain, the illumination emanating from glow lamps with bulbs of different colours, was placed in such a positio n in the basement that it was visible from all the balconies above, as well as from the stairs leading to them. To describe exhaustively the excellences of the decorations would be an almost endless task, but undoubtedly the fountain was the most conspicuous feature, and, as the atmosphere was rather overladen and close, its cool vicinity was much sought by many fair and their attendant brave.

There was commendable variety in the programme arranged for the delectation of visitors. Those who chose could roam from floor to floor and from room to room, inspecting the very numerous and valuable exhibits of machinery and scientific instruments, the excellent specimens of work performed by the trade classes attending the college, the artistic productions of other students, and, in fact, almost numberless objects of beauty and usefulness ; whilst others, to whom these were only of minor attraction, might pleasantly and profitably spend the evening by listening to the lectures and concerts which succeeded each other without interval. At the risk of being tedious we venture to enumerate some of the more noticeable of the many exhibits. An Elwell-Parker dynamo supplied current for two large plating baths in a room on the ground floor, and specimens were shown of electro-plating and electro-typing ; chemical operations were proceeding in another room ; and in still another on the same floor were a Gülcher dynamo and armature, arc lamps by various makers, apparatus used in the manufacture of incandescent lamps, secondary batteries, and various kinds of apparatus made by students of the college, notably Cockburn and Thomas's switches and cut-outs, several photometers, and a set of testing apparatus. A 2 H.P. vertical engine and a Manchester dynamo, also made by the students, were shown in the basement, where were the mechanical laboratory, containing apparatus for testing steel, iron, cement, coal, &c., Attwood's machine, models of steam engines, launches, &c., a calculating machine, and other interesting objects ; the pattern shop, in which were power and foot lathes, a circular saw, and galvanometers and resistance boxes made during the session ; the fitting shop, where exercises in chipping, filing and surfacing by Whitworth's method are ordinarily carried on ; the engine room, with boiler and 60 H.P. engine driving the dynamo for lighting the college, and other machinery, a gas engine driving a ventilating fan, and furnaces for heating the college by hot air, occupying an adjoining room; and the dynamo room, which contained an Otto gas engine of 12 H.P., an Edison dynamo lighting the college, and Phœnix, Brush, Gramme, Victoria, and Gülcher machines, for lighting and experimental work. Here it may be mentioned that the dynamo for lighting the fountain was kindly lent by the Gülcher Company. On the first floor secohmmeters, the most recent outcome of Profs. Ayrton and Perry's inventive faculties, invited attention, together with Melloni's apparatus for researches on heat, historical telegraphic apparatus, an 8-plate Wimshurst machine, and specimens of the manufactures of electrical firms, amongst them being a table full of appliances, valued at £500, lent by Messrs. Elliot Brothers, electric bells of the Coates and Macdonald Company, switchboards and cells of the E.P.S. Company, and apparatus of various kinds lent by Messrs. Woodhouse and Rawson, the General Electric Apparatus Company, the Electric Apparatus Company (Bow Lane), Messrs. Slatter and Messrs. Statter, Messrs. Paterson and Cooper, Messrs. Goolden and Trotter, Messrs. Shippey Brothers, Mr. Julius Sax, Mr. Rogers, Mr. Crocker (C. and C. motors), Messrs. Mark Baily & Co., Messrs. Beck & Co., and others. On the second floor the chemical laboratory was thrown open, and exhibits relating to and illustrating some of the industries involving chemical technology were shown ; on this floor also were the exhibits of the art department, which received their full share of attention and commendation, and the exhibits of the College Photographic Society and several of the leading photographic firms.

These, it will be admitted, comprised subjects for a long evening's interested inspection. For those who did not feel inclined to submit to the fatigue of constantly moving about, the concert and lecture rooms afforded pleasant retreats. At eight o'clock Prof. W. E. Ayrton, F.R.S., gave a short, but very entertaining lecture on "Church Bells," in which he made passing allusion to the most famous big bells, to curious inscriptions found on others embodying the tradition that bells increase in weight after they are hung, and to modern forms of church bells. Carillon machinery, Harrington tubes, and Jensen electric bells (of which there were several in the room), were each the subject of a few appreciative words of description, though the nature of the gathering and the time at the lecturer's disposal precluded any idea of technical explanation. We must not omit to state that additional interest was given to this lecture by the assistance rendered by Mrs. Ayrton, who prettily hammered out a tune on a set of musical tubes. Concurrently with this lecture a concert was proceeding in an adjoining room, the artistes being Miss Crombie, Miss Amy Martin, Miss A. Roberts, Miss Willcocks, and Miss Lang, Mr. F. W. Pinch, and Mr. F. H. Cozens. We shall avoid the invidious, and at the same time state but the bare truth if we say that each and every item was greatly enjoyed. Prof. Meldola, F.R.S., F.I.C., next occupied the lecture room and lectured to a large audience on "Spectrum Analysis," a subject easily rendered more interesting by the aid of projections from the electrical lantern. Another concert, in which, besides the ladies and gentlemen whose names have already been given, the Misses Sowerby, and Mr. Edmund St. Albyn were engaged, and a demonstration by Mr. W. E. Sumpner, B.Sc., a former student, of whom the college has good reason to be proud, on the use of the secohmmeter, filled the remainder of the evening in a most agreeable manner. With regard to the concerts, not only were those actually present at them able to enjoy the performances of the ladies and gentlemen whose services were so cordially given, but a large number of visitors in another part of the building were accorded the same privilege by means of the telephone. It is safe to say that every guest went away in the belief that the City and Guild students, if anybody, knew how to carry out in a pleasing and generally satisfactory manner the difficult and complex arrangements of a *conversazione*. Mr. R. W. Paul proved a most efficient secretary, and he was so well supported that Prof. Thompson may well feel that his students are a credit to him and to themselves.

A Great Financier.—M. Philippart, of Faure electric accumulator notoriety, is, the *Financial News* believes, posing in Paris as a financial reformer on a magnificent scale. He has conceived the idea, characteristic of his eccentric genius, of settling the French Budget by augmenting its credit column to the tune of 750 million francs, to be derived from his new scheme for producing pure alcohol ! With Philippart at the head of French finance, the credit of France would soon stand just as well as the credit of M. Philippart himself. A new Faure accumulator on a national scale, with the French Treasury at the back of it, would be something worth seeing. We shall watch the progress of M. Philippart in his new *rôle* with much interest.

NOTES.

Electric Lighting in Theatres. — The Alhambra management have recently extended their electric lighting to the footlights, which, says "Carados" in the *Referee*, is a vast improvement for all concerned.

Electric Lighting at the Diamond Fields.—Just as we are getting well over the Jubilee celebrations here in the Old Country, in come the Colonial papers with accounts of the festivities at the other side of the world. The Kimberley *Daily Independent* of June 25th contains a capital account of a fancy-dress ball given by the Mayor of Kimberley, and amongst the decorative effects especial praise is given to a device by Mr. Cousens, electrician, who installed a number of incandescent lamps of different colours and two pink arc lights.

Central Station Lighting in Austria.—The Vienna correspondent of *Industries* states that Messrs. Siemens and Halske will probably instal a central electric lighting station at Graz. The central station in Salzburg and a great portion of the distributing plant are already finished, and it is expected that regular work will begin in August. The first trial run of the central electric light station in the Schenkenstrasse, in Vienna, has been made with perfect success. When this installation is in regular work it will bring up the total number of glow lamps running in Vienna and suburbs to 32,000.

Open Air Electric Lighting.—The annual *fête* on behalf of the London and South-Western Railway Orphanage at Clapham took place on Saturday, Captain Hargreaves, of the Mount, Bishopstoke, placing his extensive grounds at the disposal of the committee for the occasion. The entertainments comprised a variety of country games and athletic sports, and at dusk the park was brilliantly illuminated with the electric light.

The Telephone in the West.—The Western Counties are being well looked after in the matter of telephonic facilities by the company which takes its name from them, and of which Mr. H. F. Lewis is general manager. An exchange was opened at Gloucester in the beginning of June, and there are now 20 subscribers; at Weymouth and Exeter exchanges were established in the first week of the present month, the former having 12 and the latter 16 subscribers. Of the older exchanges, Bristol has 400 subscribers, Bath, 33; Plymouth, 177; Portsmouth, 110; Cardiff, 43; Newport, 23; Torquay, 97; Bournemouth, 152; Swansea, 116; Southampton, 64. The Bournemouth exchange has only been in operation 15 months, and there are now 152 subscribers there. There is not a manufactory or wholesale business in the place; it is purely residential. Doctors, chemists, undertakers, grocers, butchers, and all the rest of the retail fraternity are on the exchange, as well as all the principal boarding-houses and private residences. In addition to the exchange subscribers, the Western Counties Company has some hundreds of private lines in work in its district. As soon as business warrants, it is intended to open exchanges at Worcestershire, Hereford, Shrewsbury, Falmouth, and Dorchester. There are 232 route miles of trunk wire in operation, and 50 miles more are to be opened during this month.

Telegraph Extension to the Scottish Isles.—A committee has been appointed at Stornoway to draw up a memorial to the Postmaster-General asking the telegraph to be extended to Ness and other parts of Lewis.

Gutta-Percha Monopoly in America. — It is stated that an association has been formed with a view to controlling the whole of the gutta-percha trade in the United States, a branch of business which represents a working capital of $50,000,000 and a yearly turnover of $100,000,000, and gives employment to about 25,000 hands.

Thermal Conductivities of Metals.—At a recent ordinary meeting of the Edinburgh Royal Society, Prof. Tait communicated a paper on the thermal conductivity of iron, copper, and German silver, by Mr. A. C. Mitchell. About 10 years ago Prof. Tait laid before the society the result of an exhaustive inquiry into the subject, using in the main the same method in experiment and calculation as Principal Forbes. According to these experiments the decrease in the conductivity for heat in iron is very much smaller than that given by Forbes, and is really so small that it may be said that the thermal conductivity of iron is practically the same at all temperatures. As for copper and German silver, they were found to increase in thermal conductivity with increased temperature. Both in Principal Forbes's and Prof. Tait's experiments a source of uncertainty was introduced by the excessive radiation from the oxidised surface of the experimental bars. To obviate this, the bars were plated with nickel, and the paper submitted to the society was the account of the investigation undertaken by Mr. Mitchell into the thermal conductivity of the bars so treated. Mr. Mitchell's results agree very closely with those obtained before by Professor Tait, and may now be considered as accurate and reliable as the method and experimental resources will permit.

The Electrical Resistance of Steel Solutions.—Capt. J. T. Bucknill, writing to *Engineering* in reference to some experiments upon this subject made by Mr. Bodmer, refers the latter to a communication which he made to the Society of Telegraph-Engineers, dated August 5th, 1878, and published on pages 327, 328, vol. vii., of the journal of the society. Mr. Bucknill then says:—"The experiments to discover the internal resistance of a Grove's cell therein alluded to were made at the Chemical Laboratory by the late Mr. E. O. Browne, who informed me of the fact I recorded as bearing on the subject of my communication, viz., the resistance of solid conductors when raised to a high temperature by the passage of an electric current. Mr. E. O. Browne's discovery referred to liquid conductors in the voltaic cell. Mr. Bodmer's experiments refer to liquid conductors outside the battery. My experiments refer to solid conductors. They each and all are analogous to the action which obtains in an insulating medium when an increase of the electromotive force applied produces a decrease in the resistance of the dielectric. These phenomena are probably due to the same cause—a re-arrangement of the particles by the current, thereby reducing electrical resistance. The same law is no doubt at the bottom of Mr. Kennelly's important discovery, recently communicated to the Society of Telegraphic Engineers and Electricians in a paper entitled, 'The Resistance of Faults in Submarine Cables.' Thus, he found that 'the resistances of a constant area' of fault in sea water 'vary as the square-roots of the current strengths'; or, stated differently, 'the current strengths passing through the exposure are inversely proportional to the squares of the resistances of the fault.' It is to be anticipated that were Mr. Bodmer's experiments carried out accurately the results would be found to follow, similarly, the law of inverse squares." Our article on this topic last week covered the ground taken up by Capt. Bucknill.

Last Week's Thunderstorm.—One brilliant flash of lightning and one terrific peal of thunder about midday on Friday exhausted the energies of the storm which had been threatening the metropolis for days last week. The beautiful spire of St. Bride's church in Fleet Street seems to have had a narrow escape from the lightning. At the time of the loud report of thunder flames appeared to flash from the ground at the foot of the lightning rod, and at the same time a cloud of debris, consisting of earth and broken bricks flew in all directions, together with a piece of the stone paving weighing several pounds. This was thought to have resulted from a defective earth connection, or from the extreme dryness of the earth at the spot where the rod enters the ground.

The Recreative Evening Schools Association.—We have been requested to draw attention to this association, and we do so with great pleasure. The society is doing a valuable work, having carried on classes in nearly 100 of the London Board Schools last winter, and it wishes to do as much more as possible, and to make Science Demonstrations a great feature. The classes are intended for the continuation of the training of young people between the ages of 14 and 18 who have left the day Board Schools. About 80,000 such leave the London Schools alone every year, and hitherto not 5 per cent. of them have continued their education. The science teaching is intended to be carried on mainly by lantern demonstration. Each course consists of ten or twelve lectures of a thoroughly popular but educational kind, every lecture being of about 45 minutes' duration. The proposal is that each lecturer should give the whole course of lectures on the subject he may select, and in the same school or neighbourhood, in consecutive weeks. The list of subjects for lectures are as follows: — A. Chemistry and Physics — I. Chemistry (Inorganic); II. Physics; 1. Elementary mechanics and pneumatics; 2. Elementary physical properties of air and water; 3. Sound; 4. Light; 5. Heat; 6. Magnetism and electricity; 7. Physical astronomy. B. Biology—1. Elements of animal physiology; 2. Elements of vegetable physiology; 3. Structure of leading forms of animal life; 4. Structure of leading forms of vegetable life. C. Geology and Physiography — 1. Physical geography; 2. Stratigraphical geology :—The history of the earth revealed by the stratified rocks; 3. Palœontology: — Leading forms of extinct life, fossils, coal, &c. About 50 lecturers will be required in order to supply all the schools. Additional voluntary teachers are greatly required, and any gentleman willing to give help is invited to send his name and address, the branch of science he professes, and the locality in which he would prefer to teach, to the secretary at 37, Norfolk Street, W.C. This request is backed by the following gentlemen, who form the Science Committee of the Association :—H. G. Rawson, Esq., Chairman; W. Lant-Carpenter, Esq.; C. D. Barker, Esq.; Le Blanc Smith, Esq.; Professor F. Jeffrey Bell; F. W. Rudler, Esq.; J. J. Harris Teal, Esq.; J. Edward Flower, M.A., Secretary. It should be added that the expenses of lantern, slides, &c., will be borne by the Association.

Miners' Lamps.—It is vain to expect immunity from explosion, even with the best attainable form of safety lamp, says *Invention*, if the miner cannot be trusted to refrain from making an improper use of the light put into his hands. Only last week a serious explosion occurred in a Belgian colliery, from the thoughtlessness or the foolhardiness of two miners, one of whom opened his lamp to enable the other to light his pipe. Mr. André, in the *Colliery Guardian*, considers that one of the strongest arguments in favour of the electric lamp is the fact that it cannot be opened.

A New Incandescent Lamp.—It is stated that a new incandescent electric lamp has been devised by the electrician of the Julien Power Storage Company at Brussels. The filament is said to be made of a new material and gives a discharge of electricity in the hydrogen filled bulb which produces an aureole of light. It is claimed that the illuminating power is one-third greater than in the Edison lamp for the same expenditure of energy.

Electric Lighting on the Caledonian Railway.—The Bill promoted by the Caledonian Railway for the extension of its central station at Glasgow has passed the Committee of the House of Lords. The Bill provides, among other measures, for the widening of the bridge over Argyll Street. The effect of the alteration will be practically to make a short tunnel through which Argyll Street will pass. This tunnel will be lined with white glazed bricks, and will probably be lighted with the electric light.

A Disastrous Fire.—The fire in the First National Bank building, Pittsburg, last month, destroyed all the instruments and battery of the Western Union Telegraph Company, in the operating rooms on the top floors, and damaged the switch-boards and destroyed the cables of the Central District and Printing Telegraph Company, which occupied the third floor. It is not known to a certainty how the fire originated, but it was first discovered under the Western Union switch-board, and it is supposed that rats, or other vermin, had eaten off the paraffin and cotton covering, leaving the bare wires in contact with woodwork. An alarm was sent in from two boxes and the fire department responded promptly, but as the flames were in the upper floors, which were surrounded by a labyrinth of line wires, the firemen were much hindered by having to cut their way to the building. There were eight to nine thousand cells of battery on the top floor, and these played an important part. In Pittsburg the almost obsolete practice of filling up battery cells with signal oil was followed, about eight barrels of it being used in the room. This oil of course caused the fire to burn more fiercely and rapidly, while the fluids from the broken batteries poured down the inside and outside of the building, staining everything a dirty yellow. The telegraph company immediately transferred its business, so far as possible, into the eight circuits of the Mutual Union, and ordered a carload of supplies expressed from New York. In four days they had all their wires working. But with the telephone company such promptness in resuming business was impossible, because outfits for telephone exchanges are made to order and cannot be had on very short notice. One of the eight sections of 2,000-wire multiple boards was ruined, and the other seven had to be taken apart and sent to Chicago for repairs. The exchange at Pittsburg is the third large telephone exchange that has been destroyed by fire—the others being Montreal and Toronto.

Brake Tests.—The report of the Brake Committee to the Master Car Builders' Association on the Burlington brake tests sums up the results obtained. The committee says the tests of 1887 apparently leave the field for improvement as wide open as did those of 1886. The report concludes as follows :—"While we are not prepared to make any definite recommendation at this writing as to what freight train brake should be generally adopted, our present information, derived from the recent tests, points to two conclusions :—1. That the best type of brake for long freight trains is one operated by air, and in which the valves are actuated by electricity. 2. That this type of brake possesses four distinct advantages :—(*a*). It stops the train in the shortest possible distance. (*b*). It abolishes shocks and their attending damages to equipment. (*c*). It releases instantaneously. (*d*). It can be graduated perfectly. The further question as to whether electricity is a sufficiently reliable element to use in freight train service is one that can only be determined by experiment, but we think the benefits derived from electricity are so manifest that the experiment is well worth trying. In view of the foregoing and of the improvements that the buffer and atmospheric brakes are making, your committee recommends that the subject of automatic freight train brakes be continued for further investigation." We described and illustrated the Carpenter automatic electro-air brake last week.

New Accumulator.—M. Tamine is at present engaged, states *Industries*' correspondent at Brussels, in experiments with a new accumulator having a slightly higher E.M.F. than the usual type. Preliminary experiments have shown that the E.M.F. is 2·3 volts, and that it can be maintained during the discharge of two-thirds of the total capacity. The positive plate is of the Gadot type and the negative is of metallic lead, the solution containing the following :—Saturated sulphate of zinc 1,000 parts, sulphuric acid 500 parts, sulphate of ammonia 50 parts, sulphate of mercury 50 parts.

Electricity on the "Victoria."—This magnificent steamer, the latest addition to the Peninsular and Oriental fleet, made her trial trip on Thursday week on the River Clyde. The *Victoria* is a vessel of 6,000 tons gross, and is fitted with triple expansion engines of 7,000 horse-power. The ship is fitted with every modern improvement, including two distinct engines and duplicate dynamos furnishing power for 500 incandescent lamps. The roofing of the music, dining and smoking saloons, and drawing-rooms is in the Tyne Castle tapestry, which in the light of the electric lamps has a very fine effect. Her guaranteed speed is 14·75 knots, but on the measured mile she made a speed of 17·4 knots. The electric bells and indicators on the *Victoria* were supplied by Messrs. Alex. H. Binko & Co., and the vessel is also fitted with that firm's patent batteries, bells, and indicators, the latter of which are so constructed that no matter in what position the ship may be, the signals are given with absolute certainty. There are over 200 pushes on the *Victoria*, and an idea of the magnitude of this electric signalling arrangement may be formed by mentioning that over five miles of wire have been used for that purpose. For the first time in any ship, the following experiments have been adopted in the *Victoria*, viz., the pushes in midship work alternately fore or aft, and there are reserve batteries signalled by a new kind of switch, which make a break in the system almost a matter of impossibility. We are informed that Binko's system has been likewise adopted for the other three new steamers, the *Britannia*, *Oceania*, and *Atlantic*.

An Electrical Scale Reader.—At a recent meeting of the Royal Scottish Society of Arts, Mr. G. R. Primrose read a paper on an electric meteorological scale reader, which was an apparatus for transmitting by one wire continuously, or at intervals, readings of distant instruments. It was intended to register from mountain tops or captive balloons.

Personal.—Notification is made that Mr. Joseph Davenport Finney Andrews has ceased to have any connection with the Woodside Electric Works, South Woodside Road, Glasgow, which are now under the charge of Mr. Rankin Kennedy.

Mr. M. Cooper, of the Engineer-in-Chief's Office, Postal Telegraph Department, has been promoted to the position of 1st class technical officer.

Technical Education.—Sir W. Hart Dyke introduced a Bill dealing with this subject on Tuesday, and the measure met with a very favourable reception. The Bill proposes to carry out some of the recommendations of the Commission on Technical Education which reported in 1884, and is only intended to apply to scholars who have reached the sixth standard. Technical instruction, by the Bill, would be carried on under the directorate of the Science and Art Department, and the administrative authorities would be either school boards or town councils.

A New Microphone Receiver.—Herr Hempel, of Leipzig, is said to have succeeded in making improvements in the microphone, by which the clearness of speech and strength of tone is materially increased. In external appearance this new microphone is similar to that of Ader, and in common with it the carbon contacts are not liable to get out of adjustment, the arrangement being such as to make them practically self-adjusting under almost all circumstances. The carbon pencils are arranged star fashion under a wooden diaphragm of about 6 inches diameter. The instrument is capable of transmitting the faintest whisper equally as well as a vigorous shout, and it is said that there are no extraneous noises produced, as is sometimes the case in other microphones. We very much doubt whether the improvements above mentioned are not more imaginary than real.

The Electrical Illumination of the Fleet.—From a spectacular point of view the great feature of the Royal Naval Review, which is to take place at Spithead to-morrow (Saturday), will be the illumination, chiefly by means of electricity, of the whole of the imposing fleet anchored at Spithead, together with the ships in the harbour. It may safely be said that such an extensive programme has never before been attempted, as even the torpedo and gun boats will be "dressed" with lights. On three siren blasts being given the larger vessels fitted with electric search lights will throw powerful rays of light on the shore for 10 minutes, after which, following the example of the flagship, they are to incline their lights upwards and inwards, so that the beams from the respective squadrons may combine to form a complete arch overheard. If the night should be sufficiently dark this part of the programme will doubtless be of an extremely effective character, and is sure to evoke general admiration. In order that greater emphasis may be given to the brilliancy of the series of lights, the illuminations will occasionally cease, thus rendering the ships for a time invisible. On board of each vessel will be exhibited a monogram of the letters "V.R." constructed with plain deal boards and incandescent electric lamps, this device being triced up between the fore and main masts. The illuminations are to last for an hour—between 9 and 10—and it might be as well, perhaps, if after that time some of the search lights were concentrated on the entrance to Portsmouth Harbour, as immediately the sight-seeing is over there will be a perfect myriad of craft returning to land passengers, and unless some extraordinary precautions are taken collisions may be too frequent for entire safety. During the earlier part of the present week many of the ships were partially illuminated at night, for experimental purposes, and an immense number of search lights could be seen concentrated on various parts of the town.

Electric Lighting at Barnsley.—Messrs. Wilson Hartnell & Co., of Leeds, have completed an installation for the Barnsley British Co-operative Society. The plant made its trial run last Friday night before the directors of the society and others. It consists of a 450-light Crompton compound self-regulating machine, and some 220 16-C.P. Edison-Swan glow lamps. Additions to this number will be made when contemplated alterations in the premises have been carried out. The dynamo is driven from the main engine by means of a countershaft driven direct from the main crank of the engine. The lamps are distributed throughout the mills, warehouses, offices, stores, bakery, slaughter-houses, &c., all of which are under separate and independent control. Messrs. Foden & M'Laren's engines ran the winner very closely in the single cylinder class.

Steam Engine Trials at Newcastle.—Messrs. Davey Paxman & Co., whose engines we have on several occasions spoken of, have gained at the Royal Agricultural Society's show at Newcastle the prizes for both single and compound engines. The coal consumption per brake horse-power was in the two classes of engines 2·52 and 1·8 lbs. respectively, while the water used was 22·03 and 17·76 lbs. The pressure carried was 95 lbs. per square inch in the single engine and 150 in the compound. Messrs. Davey, Paxman & Co. are to be congratulated on the results of this trial.

The Telegraph Jubilee Dinner.—Our readers are not likely to forget that next Wednesday is the day fixed for the formal celebration of the Jubilee of the Telegraph. The dinner at the Holborn Restaurant will be presided over by the Postmaster-General (the Rt. Hon. Cecil Raikes, M.P.), and a distinguished company may be expected to be present, upwards of 240 gentlemen connected with telegraphy and general science and engineering having signified their intention of attending. The Central Telegraph Office will afterwards be thrown open to the inspection of the company.

A Pacific Ocean Cable.—A *Times* telegram from Philadelphia states that the San Francisco Chamber of Commerce has resolved to petition Congress for aid in the work of establishing telegraphic communication between the United States and the Hawaiian and South Pacific Islands and Australia.

Siemens's Telegraph Works.—We understand that it is intended to close a large portion of these works at Charlton and to transfer the business of the same to Germany, a consequence, we believe, of the system of protection adopted by the German Government.

Postal and Telegraph Reform.—A meeting of members of Parliament was held in the Grand Committee room of the House of Commons on Thursday last week for the purpose of forming an association for cheapening and extending the postal and telegraphic facilities of the Empire. Mr. Henniker Heaton was unanimously elected chairman. After a discussion, the following resolutions were carried :—1. That the postal and telegraphic communication between England and all other parts of the Empire is unsatisfactory, and therefore detrimental to British interests. 2. That a Parliamentary Committee be formed for the purpose of cheapening and extending the postal and telegraphic facilities of the British Empire. 3. That meetings of the committee be held from time to time to decide on the action to be taken for advancing the object in view. 4. That Mr. Henniker Heaton and Mr. H. L. W. Lawson be appointed joint hon. secretaries of the committee. Ninety-six members of Parliament had their names enrolled on the committee. The first steps to be taken were discussed at some length. A large public meeting will probably be held soon, and the Government will be invited to appoint a Select Committee of the House of Commons to examine into the question.

The United Telephone Company.—"Investor," writing to the *Financial News*, says :—"I attended the annual meeting of the above company yesterday [reported in the ELECTRICAL REVIEW for July 8th,] with the full intention of asking some information as to the present financial position of the company, but shareholder after shareholder getting up to ask questions we were all cut short by the chairman saying if he did not at once reply to the numerous questions he had noted he would be unable to get along. All this taking so much time—the questions, his (the chairman's) replies, and the various comments thereon—I had to leave (after spending an hour at the meeting) without making the inquiry I intended. And so convinced am I that the financial position of the company is in a bad way that I disposed of my holding right out. Yet, strange, while I was in the room not one shareholder made a single remark on this important matter. With your permission, I will give the shareholders, through your valuable columns, some information taken from last year's report and the one adopted yesterday, which will, I fancy, lead prudent investors to inquire at all events. To April 30th, 1886, there was due to capital account £111,333, and the balance sheet showed the company had cash in hand or on deposit £27,102, and £40,279 was assigned to dividend. To April 30th, 1887, there appears due to capital £153,165, and the balance sheet shows cash in hand only £1,674, and, per contra, loan from bankers, £9,000. Yet £35,804 is assigned to dividend. The authorised capital is £500,000, of which only some £50,000 is as yet uncalled, and the reserve fund (£102,645)—which I had fondly hoped was being built up to meet any crisis which might occur when the patents expire in 4½ years—we were informed by the chairman, pointing his fingers in the air, "It is up there ; your reserve is in the wires, &c., of the company." There appear to me to be no assets available to pay the dividend without having recourse to the bankers, and how the company is to extend its wires and operations, with its capital account in the state it is in, is a puzzle to me ; unless, indeed, they realise some of the holdings they own in the subsidiary companies."

A Telephone Siren.—At a recent meeting of the Berlin Electrical Society, Prof. Karsten described his telephone siren. This instrument consists of a disc, to the face of which are fastened radially small steel-bar magnets. This disc is revolved by clock-work, and the pole of an ordinary Bell telephone, with diaphragm removed, is presented to the rim of the disc. The rapid passage of magnet poles induces currents in the telephone, and a musical note is produced in a telephone receiver connected with the siren. If all the magnets present the same polarity outwards, the number of complete waves produced during one revolution of the disc equals the number of magnets ; if, however, the magnets are placed with alternating polarity, the number of complete waves is half that of the magnets, but the waves are stronger. In this case, the tone heard in the receiver is the lower octave of the tone in the former case. It is also possible to arrange other combinations ; for instance, if the poles are placed in the succession N N S, N N S, &c., the tone heard is the fifth of the former. Prof. Karsten has found that this combination gives tones most readily distinguished by the human ear, and he recommends it where this apparatus is to be employed for the measurement of resistances by the use of a telephone instead of the galvanometer in bridge tests. He finds that the sound given by the siren is more easily distinguished from accidental noises which often accompany the employment of the usual make and break arrangement. By combining the siren with an anemometer it is possible to tell the strength of the wind from the tone produced in the receiver.

Gas Explosion.—A gas explosion, resulting in serious injury to two persons, occurred on Saturday at the house of Mr. A. D. Brand, at Dalston. Some time after Mrs. Brand had retired to bed she perceived a very strong smell of gas in the room. No leakage, however, could be found upstairs. On proceeding to enter a room in the front basement—Mr. Brand carrying a light—a loud report was heard, and Mr. and Mrs. Brand were blown to the extreme opposite end of the passage, both being much burnt about the face, shoulders, arms, and hands.

The Electric Light at the Suez Canal.—A Cairo correspondent of *Engineering* has lately been engaged in making an enquiry regarding the use of the electric light in the Suez Canal. He says that the use of the electric light for navigating the Suez Canal by night is feasible as regards mail steamers and men-of-war, though whether it will remain in use permanently is open to doubt. As regards ordinary steamers, officers and crews of which are not so numerous and efficient as are those of the men-of-war and mail vessels, the use of the electric light is likely to prove a delusion and a snare. Going southward in the full glare of the Egyptian desert facing the sun, unfits him much at nightfall. If at that time he exchanges the blazing sun for the dazzling electric light, by the time the vessel gets out of the Suez Canal the dazed and jaded skipper cannot be in a fit condition to take his ship the next night through reefs which abound in the Gulf of Suez, and the endeavour to avoid which calls for his utmost vigilance, care, and skill. The writer goes on to say that after a few outward-bound ships have knocked their bottoms out in that part of the world, the underwriters will awake to the fact that the electric light in the canal is to a great extent to blame for those catastrophes. Homeward-bound commanders, after running the gauntlet of the Red Sea shoals and the risks of the Gulf of Suez, find the Suez Canal a sufficiently tiresome business by day ; but to do it by night

in addition, by the aid of the electric light, means that by the time they reach Port Said every man on board will have been worked to death. It is, he further says, hard enough in the daytime to get vessels safely by the dredgers and hoppers in the canal, but at night, when the dredgers chiefly work, the difficulty will be enormously increased, and particularly as extension works are supposed to be now going on. No effort has been hitherto spared by the Canal Company to make the use of the electric light a success, so that as yet there has been an immunity from accident, which is regarded as being somewhat surprising. But when in consequence of the difficulty of judging distances by means of the electric light another dredger is capsized across the canal, or some ship is sunk in collision, causing another fortnight's delay, shipowners will perhaps begin to doubt whether this application of the electric light is such an unmixed blessing after all.

A New Dead Beat Electrometer.—M. J. Carpentier described at a recent meeting of the French Academy of Sciences a new form of absolute electrometer, which has the advantage of being perfectly aperiodic. The movable armature, which carries a pointer, is a metal strip about $\frac{4}{10}$ths of an inch wide, bent into a rectangle, and either suspended by a torsion wire in the vertical form or resting upon knife edges in the horizontal form, in which case the electrostatic attraction is balanced by gravity. This movable armature can rotate between the coatings of a cylindrical condenser composed of four quadrants. There are thus four pairs of coatings, diametrically opposite pairs being electrically connected. The novelty of M. Carpentier's design consists in making the coatings of iron, and combining with one pair of them a strong permanent horseshoe magnet, so that the armature swings in a very intense magnetic field. The eddy currents generated in the metal of the armature by its movement through the field tend to retard such movement in very much the same way as the needle of an ordinary mirror galvanometer is damped by being suspended within a thick copper casing. The result is that upon charging this electrometer the pointer moves slowly to its position of equilibrium without swinging backwards and forwards, and the instrument is therefore suitable for very rapid observations.

The Science and Art Department.—A Blue Book was issued on Tuesday containing the report for 1886 of the Department of Science and Art of the Committee of Council on Education. Eleven appendices occupying more than 300 pages are also published. The report, which is signed by Lord Cranbrook, Sir W. Hart Dyke, and Colonel J. F. D. Donnelly, the secretary, states that the statistics of science schools for the last 10 years show that the slow but steady rate of increase which obtained in previous years was somewhat accelerated last year. The number of schools examined increased by 140, the number of classes by 213, and the number of students under instruction by 6,028.

Telegraphists and Jubilee Services. — The telegraphists and their friends are not at all pleased with the tone of the Postmaster General's replies to questions respecting the labours of those useful public servants during the Jubilee celebrations. They claim that on the day preceding what has been termed "Jubilee day" they rendered services as great and as continuous as those performed on the day itself, for which the police have been so much bepraised. Yet they are not to have their extra work, which was cheerfully performed, recognised in any way, whilst the police are to have extra holidays and medals. To treat the telegraphists slightingly just now, when everyone connected with the telegraph should be in the best of spirits, would be a singularly inappropriate method of showing appreciation for the most important gift which science has made to industry in this century, and we yet hope to hear that all cause of complaint has been removed.

NEW COMPANIES REGISTERED.

Chatham, Rochester, and District Company, Limited.—Capital, £10,000 in £5 shares. Objects: To carry on in all branches the business of an electric lighting and electric motive power and supply and telephone company in all branches. Signatories (with 1 share each) *H. Jasper, *C. T. Smith, W. Evelings, F. Wingrove, G. Church, J. Taylor, *W. J. Mackey, all of Chatham and neighbourhood. The signatories denoted by an asterisk are the first directors. Qualification, 20 shares; the company in general meeting will determine the remuneration of the board. Registered 15th inst. by T. H. Philpots, 25, Bedford Row. Solicitors, Norman and Shgant, Chatham.

Croydon and District Electric Lighting Company, Limited.—Capital, £20,000 in £5 shares. Objects: To carry on in Croydon and neighbourhood the business of an electric light, heat, and power company in all branches. Signatories (with 1 share each) *J. Stent, Thornton Heath; T. Floyd, C.E., 3, Victoria Mansions, S.W.; *R. J. Hinton, Bramley Hill; J. Klem, M.A., Thornton Heath; T. Pook, Thornton Heath; *D. B. Miller, Thornton Heath; Hy. Johnson (electrician), 1, St. Swithin's Lane, E.C. The signatories denoted by an asterisk are the first directors. Qualification, 20 shares; minimum remuneration, £100 per annum. Registered 18th inst. by Edmund Dean, 37, Walbrook.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Consolidated Telephone Construction and Maintenance Company, Limited.—The annual return of this company, made up to the 16th ult., was filed on the 15th inst. The nominal capital is £243,787 10s., divided into 224,850 shares of 15s. each, and 75,150 shares of £1 each. 224,850 shares are held and £1 per share has been called up. These shares have been reduced by special resolution to the nominal value of 15s. each.

CITY NOTES, REPORTS, MEETINGS, &c.

Eastern Telegraph Company, Limited.

THE thirtieth half-yearly general meeting of this company, as stated last week, was held on the 14th inst. at Winchester House, Old Broad Street, Mr. John Pender, chairman of the company, presiding.

Mr. George Draper, Secretary, having read the notice convening the meeting,

The Chairman stated that the revenue for the six months ended March 31st last had been £331,862, being a decrease of £9,543 compared with that of the corresponding period of 1886. The balance brought forward from the last half-year's accounts was £19,458 less than in 1886. They now had to deal with the sum of £28,902 less than at that time last year. The total working expenses for the half year had been £83,035, or a decrease of £9,209. That arose in a measure from the absence of extraordinary expenses, which were unavoidable in time of war. The general expenses in London had been £8,169, being a decrease of £604. The working expenses at stations had been £60,674 against £64,439. The expenses attending repairs and renewals of cables had been £43,903, being an increase of £2,266. One of the item in that account was for the completion of the repairs to the Direct Lisbon cable, which had now been almost entirely renewed. One of the company's ships, the screw steamer *John Pender*, had been fitted up with new boilers and improved electric light, and thoroughly overhauled and re-classed at Lloyd's. The expenses of carrying out that work, together with the extensive alterations and improvements which were made to the hull, and picking up the gear, &c., of the screw steamer *Volta*, had been charged to maintenance ships' fund. They had laid in about 135 miles of new cable during the six months. Notwithstanding the reduction in revenue to which he had referred, it was satisfactory to find that after charging all expenses, including income tax, providing for interest on debentures, debenture stock and preference shares, they were still able to pay a dividend and bonus on the ordinary shares at the rate of 5½ per cent. for the year, and to carry forward £48,000 to the general reserve fund. When he had the pleasure of addressing them last January he told them that

they had been paying a bonus for some two or three years, but he then stated that the reductions which were forced upon them at Berlin took away something like £40,000, and that that practically did away with their bonus. He thought that on the same occasion he shadowed forth the probability—believing as he did in the recuperative power of the telegraphic system—that a year would not pass away without at any rate their being able to pay some portion of, if not all, the bonus. Strange to say, during the first few months of the reduction in the rates there had been a decrease rather than an increase in their traffic. That, however, was temporary, and he was glad to say that in the last two or three months there had been an increase, and they were now enabled to pay for the six months a bonus of ½ per cent. He hoped that would be satisfactory to the body of the shareholders. Since he last addressed them they had connected Tangiers with their cable system in Gibraltar. They found that there was a great want of telegraphic communication, and they were requested to do this work, which, he was glad to say, had met a great public want. The cable was working satisfactorily, and the return had been much in advance of what had been anticipated. That would be another feeder to their system. The Italian Government had also, under the company's more immediate eye, laid a telegraph connecting Massowah and Assab with the company's station at Perim. That would be an additional feeder to their system. The company undertook to protect that cable for three months, for which they received £5,000; and that was very satisfactory, seeing that no work had been required from them for it. There was another important question which he shadowed forth at the last meeting. He then said that to make themselves thoroughly independent it might be necessary to lay another cable from the Land's End to Gibraltar and Malta, to make them entirely independent of their cable system through France. Looking at the state of affairs on the continent, probably they had not undertaken to do that work one day too soon. Any one reading the *Times* of that day must be struck with the critical position in which Europe was at the present moment. It had always been the policy of the directors to be ahead of requirements in their work. They believed they had the support of the shareholders in thus acting, as long as they saw their way to maintain their dividend. In carrying out this work they would saddle the company with a very small amount of capital, and it would give them independence in maintaining their dividend. They had had a line through France for some years, which they had occupied very considerably, but they had felt that it was not a safe line to rely upon, and difficulties were being thrown in their way by the French Government to their renewing the concession. They had before anticipated the wants of the Government, and they believed that they were now anticipating the requirements of the Goverment and of the nation, and that in doing so they were adding to the stability and position of the company. That cable could be laid and working within the next two months, and it could be laid sooner if desired. They intimated to the Government the amount they would have to pay if at any time they required a preferential working of that cable. He believed that what they had done would commend itself to the Government, as he was pleased to find it had commended itself to the shareholders. During the last six months they had lost another steamer, the *Volta*, but they could not understand how it had occurred except on the plea that the captain and officers of the ship had become so accustomed to sailing among the islands of the Greek Archipelago that they had got to believe that the ship could take care of itself. The Board of Trade had made a very careful enquiry, and had relieved the company from all blame, reporting that the vessel had been kept in a most efficient condition. The misfortune had been attended with no pecuniary loss to the company. The insurance money would pay for the ship they were now building to replace the *Volta*. Their 5 per cent. debentures were terminable on the 1st of August, and they had decided to issue 4 per cent. mortgage debenture stock to replace them. The stock was being taken up pretty freely by those who had the 5 per cent. debentures. The change would effect a certain saving to the company, and he thought it showed the solid position in which the company stood with the investing public. In the earlier stages of the company he had said that the property was a property the importance and value of which they had yet to learn. Every year had taught them that they controlled and commanded it. If a fault occurred to-day, they could say within a few days, almost to a certainty, that the fault would be repaired. Therefore, they had established what might be called a permanent property, and in that light it was being viewed by those who were taking up the 4 per cent. debenture stock. It was during the last 20 years that submarine telegraphy had been established and brought to its present position, and probably nothing had been done during the 50 years' reign of Her Majesty that had left a greater mark upon human progress than the submarine system of telegraphy. The subject of federation had been much talked about. He maintained that the submarine telegraph system had been the means of bringing about a great moral confederation. It had brought our colonies and the mother country into daily, almost hourly communication. He thought they might congratulate themselves as a company on the great work they had done. He trusted that that work would continue, that the telegraph would play an important part in preventing war, and that if war did occur it would play a still more important work in bringing it to a close. He concluded by moving the adoption of the report, and the declaration of the dividend and bonus recommended.

Mr. G. G. Nicol seconded the motion.

Mr. Newton, Mr. Griffiths, Mr. Fowler, and Mr. Husband havin spoken,

The Chairman said that the existing 5 per cent. debentures were a terminable security, while the 4 per cent. mortgage debenture stock would be a permanent security, and have a first charge on the company's undertaking. When they established the bonus principle it was pointed out that the amount would be of a fluctuating character, and they agreed to consider 5 per cent. as the dividend. He hoped next half year that they might again pay the ½ per cent. bonus. In keeping ahead of the wants of the Government and of the country they had received very great and important consideration from the Government. For instance, they had the exclusive right for a great many years of landing cables in Egypt. If they were to stand still they would go back, and, in fact, they must meet the demand on them as far as possible and be ahead of it. In answer to Mr. Husband, he stated how they proposed to pay for the new cable, pointing out that the capital would be saddled with only £75,000. By the arrangements contemplated in connection with the new cable they hoped to save £21,000 a year, which they would practically get towards the payment of the interest on the new capital. He looked forward to a very large increase in their traffic. In reply to Mr. Fowler's question they were going to raise the money for the new cable in such a way as to add but little to the capital. The present arrangement with France would would continue till next year; but that country might be in a blaze to-morrow. Their ship was at Porthcurnow, with a large amount of cable on board for the new line. Some day they would have an alternative line from Bilbao to Barcelona connecting with their system, and from Barcelona they would connect with their own system at Gibraltar at a very small expense. That would give them another line.

The motion was then unanimously adopted, and, after a vote of thanks had been accorded to the chairman and directors, the meeting terminated

India Rubber, Gutta Percha and Telegraph Works Company, Limited.

THE half-yearly meeting of this company was held at the Cannon Street Hotel, under the presidency of Mr. S. W. Silver, on Tuesday.

Mr. W. J. Tyler, the Secretary, having read the notice convening the meeting,

The Chairman said that, as the shareholders were aware, the books of the company were not made up until the close of the year. They would not be surprised to hear that the same keen competition that he had already alluded to was still to be met with, and he need scarcely remind them that that fact required, on the part of the manager and others, the greatest possible amount of attention to effect sales, which, however, he hoped would be found, when the books were made up, to justify the motion he would make, namely, that an interim dividend of 5 per cent., or 10s. per share, tax free, and payable on the 20th inst., be declared.

Mr. Neil Bannatyne seconded the motion, which was unanimously agreed to.

Mr. Treble moved, and Mr. Webber seconded, a vote of thanks to the chairman and directors, which was carried, the meeting thereupon terminating.

Telegraph Construction and Maintenance Company, Limited.

THE half-yearly meeting of this company was held at the offices, Old Broad Street, Sir George Elliott, in the absence of Sir Daniel Gooch, who was recently thrown from his carriage, presiding.

Mr. Shuter, the general manager, having read the notice convening the meeting,

The Chairman stated that with regard to the work done during the half-year they had connected the Italian ports on the Red Sea with Aden, using 359 miles of cable, and they had repaired the German Union Company's cable, in the North Sea. With regard to the more important work which they were now engaged upon, the *Scotia* left England on the 11th inst. with 1,300 miles of cable on board to connect the Land's End with Lisbon, Gibraltar and Malta, and was now carrying out the work. The company found it almost necessary to duplicate their work, and wherever there was one cable another in the course of time was required. That was very much what constituted the life as it were of this company, and so long as they could go on paying their dividends he was sure they would always be quite certain of the confidence of the shareholders. He had no resolution to submit to the meeting. In reply to a question, the Chairman said he believed the directors had under their serious consideration how far the experiment with the electric light which they had already made for the Great Western Railway Company could be utilised for developing the business of the company.

The usual votes of thanks terminated the proceedings.

Anglo-American Telegraph Company, Limited.

THE report of the directors states that the total receipts from the 1st January to the 30th June, 1887, are estimated at £100,534 9s. 3d. This amount, however, is subject to revision, dependent upon the result of the law suit now pending between this company (on behalf of the Associated Atlantic Cable Companies) and the Paris and New York Telegraph Company. The traffic receipts show a

decrease as compared with the corresponding period of last year of £16,492 consequent upon competition, a reduced tariff, and the fact that from 1st January to 4th May, 1886, the 1s. 8d. rate was in force.

The total expenses of the half year, including repair of cables, &c., as shown by the revenue account, amount to £47,211 2s. 7d.

One quarterly interim dividend of 5s. per cent. on the ordinary stock, and of 10s. per cent. on the preferred stock, was paid on the 1st May, 1887, absorbing £17,500, and second quarterly dividends of similar amounts will be distributed on the 30th July, 1887, leaving an estimated balance of £18,323 6s. 8d. to be carried forward to the next account.

The company's repairing ss. *Minia* has been engaged during the past half year in the repair of the 1873 cable off Valentia, Ireland, and the St. Pierre-Duxbury cable off Seal Island, Nova Scotia. She has also executed three repairs for the Direct U.S. Cable Company and two for the Western Union Telegraph Company, the remuneration for which will be found in the revenue account.

The company's system of cables and land wires is in good working order, with the exception of the Brest-St. Pierre and St. Pierre-Duxbury cables, the former of which was broken in deep water at a distance of 600 miles from St. Pierre on the 9th of November, 1886, and the latter in shallow water at a distance of 380 miles from Duxbury, on the 15th June, 1887. The company's ss. *Minia* left London on the 14th instant with 300 miles of deep sea cable on board to effect the necessary repairs.

The notice given by the Paris and New York Telegraph Company on the 31st December, 1886, to determine thenceforth, so far as that company was concerned, the joint purse agreements of the 24th September, 1880, and the 12th May, 1882, was submitted to eminent counsel in Paris, and, upon their advice, the Associated Cables Company resolved that an action should be brought by the Anglo-American Telegraph Company against the Paris and New York Telegraph Company before the Paris Tribunal of Commerce to enforce specific performance of the agreements under heavy penalties. This action is now proceeding, but, as the accumulation of business before the Tribunal of Commerce is very great, it is feared that the hearing will not take place for some time.

The tariff of 6d. per word has been in operation during the whole of the past half year, and has resulted in a still further increase of traffic carried by the associated companies. In consequence, however, of the Paris and New York Telegraph Company not having rendered their accounts for the period now under review, it is difficult to give a reliable estimate of the entire increase which has taken place; but inasmuch as the three companies which still work under the joint purse agreements have carried a much larger traffic than they did in the half year ending the 31st December, 1886, it is fair to assume that the total number of words carried at the sixpenny rate must have been largely augmented.

The Anglo-American Brush Electric Light Corporation, Limited.

THE following circular has been addressed to the shareholders of this company by Mr. E. Garcke, the secretary:—"I am instructed by the directors to inform you that, of the 5,000 new shares recently offered for subscription in pursuance of the resolution passed at the last general meeting of the shareholders, only 1,354 shares have as yet been taken up.

"The additional capital thus provided is not sufficient to meet the requirements of the corporation as a result of the acquisition of important undertakings in Austria-Hungary, and of other investments made for the purpose of further developing its business, and maintaining and strengthening its position.

"Having regard also to the fact, already known to the shareholders, that the increasing business of the corporation has for some time past been conducted under disadvantages, consequent upon inadequate working capital, the directors have decided, that in the best and permanent interests of the proprietory, it is desirable to make a call of £1 per share on the shares upon which only £3 per share have been paid.

"This call will enable the corporation to satisfactorily complete the arrangements already sanctioned by the shareholders for the necessary extension of its manufacturing and other operations, and by placing the finances on a more favourable footing facilitate the carrying out of important contracts.

"The directors have pleasure in stating, that considering the present depressed state of the electric light industry, the business of the corporation continues to improve in volume, though in face of keen competition and consequent fall of profits it is necessary whilst practising the most rigid economy to secure all the advantages which a command of adequate working capital affords."

The Globe Telegraph Company, Limited.—This Company announces a final dividend of 3s. on preference shares, less income-tax, and 2s. 3d. on ordinary shares (income-tax already deducted), making a total dividend for the year of 6 per cent. on preference and 2½ per cent. net on ordinary shares.

The Submarine Telegraph Company, Limited.—Subject to audit, the accounts for the half-year ending June 30th show a balance which enables the directors, after adding 15 per cent. of the gross receipts to the reserve fund, to recommend a dividend at the rate of 12 per cent. per annum.

NEW PATENTS—1887.

9829. "Dynamo-electric machines." T. STANLEY. Dated June 13.

9843. "Compensating electric measuring instruments for temperature." W. T. GOOLDEN, S. EVERSHED. Dated July 13.

9853. "Dynamo-electric machines." H. WATT. Dated July 13.

9871. "Electro-dynamic and dynamo-electric machines." J. GIBSON. Dated July 14.

9876. "Dynamo-electric machines." R. DICK, R. KENNEDY. Dated July 14. (*Complete.*)

9904. "Producing insulating coatings or tinings in electrolytic apparatus." L. GRABAU. Dated July 14.

9905. "Underground conductors of electricity." R. E. B. CROMPTON. Dated July 14.

9921. "Continuous air brakes; operating same by electricity." W. FURST. Dated July 15.

9979. "Circulation of electrolyte in electric depositing vats, &c." R. E. B. CROMPTON. Dated July 16.

10009. "Electric time danger signals for railways." G. H. WRIGHT. Dated July 16.

10056. "Contact apparatus for use in automatic electric signalling on railways." W. WALKER. Dated July 18. (*Complete.*)

10057. "Extracting aluminium from its fluorides by electrolysis." E. DE PASS. (Communicated by M. and E. Bernard.) Dated July 18.

10071. "Fittings for electric incandescent lamps." W. B. SAYERS, W. H. STURGE. Dated July 19.

10091. "Transmitting articulate sounds by agency of electricity." H. J. ALLISON. (Communicated by S. L. Barriett.) Dated July 19.

10092. "Insulating material for electrical conductors or other uses." R. W. EDDISON. (Communicated by J. Tatham.) Dated July 19. (*Complete.*)

10115. "Electric switches." W. E. HUNNEX. Dated July 19.

10116. "Apparatus for automatic imparting of electric shocks, &c." J. S. WALLACE. Dated July 19.

10131. "Meters or apparatus for measuring electricity." G. FORBES. Dated July 19.

10157. "Transmitting and receiving electrical signals." T. A. GARRETT. Dated July 20.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1886.

2880. "Improvements in and relating to apparatus for the generation and utilisation of electrical energy." H. H. LAKE. (Communicated from abroad by G. E. Cabanellas, of France.) Dated February 27. 1s. 7d. This invention relates chiefly to improvements in magneto-electric machines or apparatus. The claims are 12 in number.

4751. "Improvements relating to the application and utilisation of magnetism or electro-magnetism for the separation of metals and for other purposes, and to apparatus therefor." H. S. MAXIM. Dated April 5. 1s. 1d. Two circular series of electro-magnets are mounted on a shaft which is carried in suitable bearings in the frame of the machine. At the top of the machine there is a hopper, and beneath this hopper is arranged a shaking or vibrating tray or chute for feeding the substances to be treated from the said hopper into the machine. A spout or chute is provided at the bottom of the machine for the discharge of the sand or other non-magnetic material after the gold has been separated therefrom. Spouts or chutes are also provided for receiving the gold and conducting the same into suitable receptacles. Deflectors or deflecting plates are arranged in proper relation to the magnets to prevent the rotation of the particles of gold with the said magnets. A ring or annular piece is attached to, but insulated from, each series of magnets. The coils of the magnets are connected with these rings or annular pieces; and contact springs or brushes, connected with an electric generator, are arranged to bear one on each of the said rings. The diaphragms which cover the poles of the magnets are stretched, or otherwise mounted upon stationary frames. The operation of this machine is as follows, viz:—A suitable current of electricity is taken in through one of the contact springs or brushes and out through the other spring or brush; and the magnets of each series are thereby excited, thus producing between the two diaphragms a very powerful magnetic field in which there are many changes of polarity. The shaft and the two series of magnets are now rotated at a high speed, and the material to be operated upon is placed in the hopper, and fed forward so that it falls in a continuous stream into the space between the two diaphragms. The material which is affected by the magnetic force of induction will be powerfully impelled or deflected in the direction of rotation and thrown into the chutes provided for its reception. The material which is not acted upon by the magnetic force or induction, or which is very slightly acted upon thereby, falls directly into and through the bottom chute and is discharged from the machine. The claims are 11 in number.

7004. "Improvements in apparatus for generating currents of electricity and in electro-motors." R. E. B. CROMPTON. Dated May 25. 8d. Claims:—1. In apparatus for generating currents of electricity, the combination or arrangement and use of a dynamo-electric machine with an engine so as to be driven direct by an engine or turbine arranged without a separate bed plate or separate bearing for the dynamo in manner substantially as described and shown in the drawings. 2. In apparatus for generating currents of electricity the combination or arrangement and use of an electric-dynamo machine with the engine driving it; the dynamo having its armature mounted on the shaft of the engine or turbine having a bearing common to both the electro-dynamo machine and the engine driving it, substantially as shown and described. 3. The combination or arrangement of parts of an electro motor so as to effect the driving of a machine directly, said machine being arranged with a bearing common to the electro motor and machine, substantially as described.

7109. "Improvements in electro-telephonic apparatus." A. A. CAMPBELL-SWINTON. Dated May 27. 8d. Claims:—1. In electro-telephonic apparatus in or for the transmitting or receiving instruments, a drum head made by joining two or more membranes of the nature described, together with an armature, by means of a resin such as shellac, liquified by fusion or heat, substantially as described. 2. In electro-telephonic apparatus in or for the transmitting or receiving instruments, a drum head made of a membrane or of membranes of the nature described with an armature, and covered or coated by a resin or shellac applied thereto by fusion or heat, substantially as described. 3. The manufacture of drum heads for telephonic transmitters or receivers by connecting or coating (or both) a membrane or membranes of the nature described and an armature by means of a resin, such as shellac fused or liquified by pressing between heated plates, substantially as described. 4. For telephonic transmitters or receivers a drum head and armature of the kind described and claimed by either of the preceding claiming clauses, mounted on a ring with an armature connected to the ring by a tongue or by tongues (or independent of the ring) and secured in the instrument, all substantially as described. 5. In telephonic apparatus the combination of two or more parallel circuits at each station of the line, there being a battery in one of the parallel circuits at each station of the line, and telephone receivers, transmitters, or parts of these or the secondary of the induction coil in each of the parallel circuits at each station of the line, substantially as described with reference to the several examples given in the drawings. 6. In telephonic apparatus as claimed by the last preceding claiming clause, the balancing of the batteries at the station of the line, substantially as and for the purpose described. 7. In telephonic apparatus as claimed by either of the last two preceding claiming clauses, wherein induction currents are used, the employment of a condenser in the main line, substantially as and for the purpose described. 8. The several telephonic arrangements described and illustrated in the several figures of the drawings. (See REVIEW for June 10th, 1887.)

7353. "Improvements in galvanic batteries." P. RAOUL DE FAUCHEUX D'HUMY. Dated June 1. 11d. The invention has for its object a novel construction and arrangement of parts whereby facility is afforded for examination, cleansing, and renewal of the battery for instantly putting the same into and out of action, and for constantly maintaining the power of the battery while the same is in action. The inventor arranges a number of rectangular exciting cells or chambers side by side in a movable tray placed on guides in an enclosing box or chamber in such manner that the cells or chambers can be readily slidden into and out of position separately from the tray or collectively by sliding the tray out of the enclosing box or chamber. The said exciting cells or chambers are provided at each end with a porous cell, or are fitted with porous diaphragms so as to form separate small chambers at each end thereof. In the said porous cells or small chambers, and in the central or main portion of the exciting cells or chambers, is placed the exciting liquid, and in the said exciting cells are placed the metal and carbon elements or electrodes. The liquid in the porous cells or small chambers gradually passes through the walls of the porous cells or through the porous diaphragms into the exciting liquid in the central cell, which is thus gradually and continuously reinforced in proportion to the loss it sustains when the battery is in action. A series of metal and carbon plates or electrodes are placed in each exciting cell or chamber. The plates can be lifted out of the liquid by means of a hinged board to which they are attached. The claims are 3 in number.

8513. "Improvements in the manufacture of carbon filaments or other conductors for incandescent electric lamps." W. MAXWELL. Dated June 29. 6d. Claims:—1. In the preparation of carbon filaments or other conductors for incandescent electric lamps, electrically heating them in a vessel through which continuously during the process is caused to flow a stream of coal gas, or equivalent hydro-carbon fluid, at a reduced pressure and constant temperature, substantially as described. 2. The described method of controlling the deposit of carbon on a conductor for an incandescent lamp by first gauging its sectional area and then depositing carbon on the conductor while it is electrically heated to a standard incandescence until the electric current required attains a pre-determined strength.

10331. "Improvements in regulators for electric arc lights." A. J. BOULT. (Communicated from abroad by Dr. Stefan Doubrava, of Prague.) Dated August 12. 8d. Consists essentially in combining the arc light with certain resistances in such a manner that systems of electromagnets and solenoids without mechanism can be used for the direct regulation of the arc light, such systems having neither a constant attraction nor a symmetrical attraction curve, conditions which are essential and necessary to the regulators hitherto in use. The regulation of this regulator is perfectly independent of the attraction and only requires a system of electromagnets and solenoids in which, by reversing the current in one part thereof, the direction of the movement is also reversed. The claims are 3 in number.

CORRESPONDENCE.

"Vested Interests in Bath."

Under the above heading you had an article in the ELECTRICAL REVIEW last week, which had reference to the opposition on the part of certain members of the Bath Corporation to the use of the electric light in this city. Can you, for the benefit of myself and others who are desirous of popularising the use of electricity, define the position of gas shareholders who are members of a town council? In one town, in the West of England, no shareholder in the local gas company is allowed to be on the lighting committee, or to speak or vote on the lighting question.

In another, the present town clerk was a shareholder in the local gas company, but was required to sell his shares before he could hold this office.

In Bath, however, things are quite different, and not only is our town clerk (a gentleman for whom I have great respect) a shareholder and director of the local gas company, but a large proportion of the town council are also in the same way pecuniarily interested in the lighting question, and they appear hitherto to have been allowed, practically, to give themselves contracts, with the not unnatural result that the gas supplied gives anything but satisfaction to the citizens.

H. G. Massingham.

June 20th, 1887.

[Town Councillors, we believe, are subject to no other control in this matter than the general tenets of right feeling and conduct. We are sorry to learn that good sense and the appreciation of proper motive are at such a low ebb in the council of so famous a city as Bath. The citizens, we may remark, have a remedy when election time comes round for any grievance they may have.—EDS. ELEC. REV.]

Cable Tests.

Kindly permit me to draw your attention towards a fact which presents some interest. Having lately been engaged in applying a series of various tests to an artificial cable, I tried, amongst others, the "*inferred zero*" method proposed by Messrs. Thomson and Jenkin. My arrangement was essentially the same as used by the inventors,* with the exception, however, that the electrometer was *Mascart's* (manufactured by T. Carpentier, Paris), whose needle received its charge by 300 small zinc-copper couples immersed in little pots filled with plain water. The testing battery, 24 large Leclanché cells, had its poles constantly joined by a great resistance, which consisted of two boxes, one 10,000 and the other 100,000 S.U., therefore the full potential of the battery (when applying the wire to the end of the 100,000 coil), or the eleventh part of it (applying the wire at the point of junction of the two boxes), could easily be obtained.

The test was carried out according to the prescriptions given by the inventors. Nevertheless, I found that the electrometer zero always shifted when the battery was applied to the cable, and yet, the short circuit plug being in, the two pairs of quadrants ought to have been

* *Journal Soc. Tel. Engineers*, vol. II., 1873, p. 169; Munro and Jamieson, "Pocket Book," 1st edit., p. 151; Kempe, "Electric Testing," 3rd edit., p. 325.

on the same potential. But the most extraordinary thing is, that on this very perfect cable the readings with copper and zinc differed very much.

Example.—Deflection with one-eleventh potential of testing battery = 116·5 divisions, therefore inferred zero = 116·5 × 11 = 1281·5. Copper to cable, charge 15 seconds, deflection 1 minute after removing short circuit plug,

1st minute 73·5 divisions.
2nd „ 111 „

True readings—

1st minute 1281·5 − 73·5 = 1208
2nd „ 1281·5 −111 = 1170·5

therefore

W = 11·53 megohms.

Zinc to cable. Inferred zero = 1281·5.

1st minute 56·5 divisions
2nd „ 86·0 „

True readings—

1st minute 1225
2nd „ 1195·5
W = 14·9 megohms.

The ordinary insulation test, executed with a very sensitive Thomson's galvanometer and the same battery, gave, at the same temperature (12° C.)—

Copper, 1st minute 9·36 megohms
2nd „ 16·72 „
Zinc, 1st „ 9·46 „
2nd „ 17 „

I repeated the tests many times, taking the greatest care with regard to insulation of electrometer and leading wires, but there remained always a very marked difference between the two readings, sometimes up to 4 megohms.

Perhaps you, or one of the numerous cable electricians among your subscribers, will be kind enough to give some information on the subject.

Dr. A. Tobler.

Zurich, *July 12th*, 1887.

[It is somewhat difficult to decide with certainty upon the points raised by Dr. Tobler without fuller explanations of the mode of procedure, but it would appear evident, in the first place, that the shifting of the zero when the battery was applied to the cable, *i.e.*, to the quadrants, the latter being connected together by the short-circuit plug, must be due to a want of symmetry in the arrangement of the quadrants; this, of course, has nothing to do with the cable being connected to them, and would have been equally noticeable had the battery alone been joined to the same. As regards the discrepancy observed in the two methods of measuring the insulation, Dr. Tobler has unfortunately omitted to state the order in which he took the readings, but if he has followed the usual practice of taking the zinc reading first (although in the letter the reverse order is given) the effects are accounted for by *absorption*. Dr. Tobler does not state whether he thoroughly discharged the artificial cable after taking the readings with the zinc charge and before (presumably) testing with the copper charge; if he did not do so, the observed effects are easily accounted for. We presume the artificial cable was formed of paraffined condensers; such condensers are most strongly absorbent, and it will be found that even after they are apparently thoroughly discharged by being short-circuited for a long period (in some cases for an hour or more) that on the short circuit being opened and the condenser allowed to rest for some time a considerable free charge will be found to have accumulated. In the test made by Dr. Tobler, whilst the reading is being observed on the electrometer, say, with the zinc charge, not only is the charge leaking out, but it is also in part becoming absorbed, and when the reading is made with the copper charge the latter not only leaks out through the insulation, but also unites with the absorbed zinc charge which is developing itself, as it were, out of the pores of the insulation; this would, of course, hasten the rate at which the potential would fall, as was observed. With regard to the nearer approximation between the zinc and copper readings in the case of the insulation test by direct deflection, this is probably due to the fact that owing to the battery being continually connected to the cable the potential of the same is always maintained constant, and possibly the absorption effect is thus swamped as it were, though in this case also Dr. Tobler's figures show that a higher deflection is obtained with the copper than with the zinc current. We shall be glad to have the opinion of any of our readers on the subject, but Dr. Tobler's statement with reference to the order in which the tests were taken, and also as to whether the cable was thoroughly discharged between the zinc and copper tests, requires to be obtained before any definite opinions can be given.—EDS. ELEC. REV.]

Driving of Dynamos by Short Belts.

I have read with considerable interest the paper on the above subject compiled by Profs. Ayrton and Perry, and read by them before the Society of Telegraph Engineers, on May 26th, an abstract of which is published in your valuable journal of the 8th inst.

From the mechanical arrangement which they suggest, it appears they have weighed up the difficulties to be contended with from many standpoints, and they certainly deserve great credit for opening up a subject which will be of so much value to electrical engineers as well as others.

It (the arrangement) could, no doubt, be applied in many cases with advantage, but, is not the "arc" of contact of the belt on the small pulley very much too small for high speeds like 1,500 or 2,000 revolutions per minute, and perhaps over? The belt is bound to "creep" to a certain extent, as the "adhesive grip" or "bite" in any small surface cannot possibly be so good as in a large.

Again, they broadly lay down "ship lighting" as being its special "claim" where the space for machinery is very limited. Have Profs. Ayrton and Perry really considered the difficulties to be contended with in adapting it to this purpose? They will doubtless know that there is little comparison between fitting their "driving gear" on board ship and fitting it in the "Central Institution." Will not the vibration of the engines, nor the rocking of the ship have any serious effect on it? It seems to me that the relative position of the shafts to each other would be always changing, the one machine being held in one position, while the other was free to accommodate itself to the movement of the ship, thereby, in addition to altering the line of the shafts, also altering the pressure on the belt and causing it to "creep" or "slip" to a very great extent. Is not this the case? I'm afraid Profs. Ayrton and Perry would experience some difficulty in keeping up a "constant speed" under these conditions, if they were even able to keep the belt from being thrown off the pulley.

The most novel feature in this gearing, however, is in connection with the pressure on the bearings; they say, "The pressure on the bearings can be actually made nought." If this statement is correct, they have really conquered a most destructive enemy; but I think in making such a remark they exaggerate too much the merits of their design. Why should they mar a success by claiming too much for it? There is bound to be a pressure in an upward direction, however small, before the machine can accommodate itself to the belt or before any movement can be imparted to the trunnions.

Doubtless many of your readers, as well as myself, would like to be enlightened on these points when the authors have time to give them their further consideration.

C. E., Jr.

July 18th, 1887.

The Maximum Efficiency of Shunt Motors.

The efficiency of an electric motor, as is well-known, is expressed by the equation $\frac{W}{w} = \frac{e}{E}$ where W is the total electrical work absorbed, w the amount converted into mechanical work, e the difference of potential between the terminals, and E the counter E.M.F. of the machine.

But though this is true for magnet and series motors, it is by no means true for shunt motors. That is to say that, in the case of a shunt motor supplied with a constant difference of potential, it is not economical to increase the speed and cut down the current beyond a certain point, that certain point being the most economical speed at which that motor can be run.

To find out this speed, let x stand for the current through the armature, and let a, c and b respectively stand for the E.M.F. of supply, resistance of armature and resistance of field magnet coils. Then the total power absorbed bears a certain ratio to the power wasted in heating the armature and field magnet coils, and the greater this ratio, the greater the efficiency. Call this ratio y, then

$$a\,x + \frac{a^2}{b} = y\left(\frac{a^2}{b} + c\,x^2\right),$$

and solving for x we get

$$y\,c\,x^2 - a\,x + \frac{a^2}{b}(y-1) = 0,$$

or

$$x = \frac{a \pm \sqrt{a^2 - \frac{4\,a^2\,y\,c\,(y-1)}{b}}}{2\,y\,c}$$

Now the greatest value that y can have here is when

$$\sqrt{a^2 - \frac{4\,a^2\,y\,c\,(y-1)}{b}} = 0,$$

or

$$\frac{4\,a^2\,y\,c\,(y-1)}{b} = a^2.$$

Solve for y in this equation and we get

$$y^2 - y - \frac{b}{4\,c} = 0$$

and

$$y = \frac{1 + \sqrt{1 + \frac{b}{c}}}{2}$$

Now $x = \frac{a}{2\,y\,c}$ (the radical being $= 0$)

Therefore with y a maximum

$$x = \frac{a}{c\left(1 + \sqrt{1 + \frac{b}{c}}\right)},$$

and this is the value required. Thus we see that for every shunt motor there is a certain speed which is more economical than any other, this speed being such as to reduce the current through the armature to the value found above.

C. G. McEwen.

Durban, *June 17th*, 1887.

Telephone Patents.

I send to you a supplement to the letter of J. G. Ross in your excellent REVIEW of June 24th, in reply to the enquiry by "Puzzled" in your REVIEW of June 17th; I shall confine my remarks to citing the evidence of a magneto-receiver described by Chas. Bourseul in the *L'Illustration*, a newspaper published in Paris, August 26th, 1854, and subsequently described in a book, entitled "Les Merveilles de l'Électricité," by J. Baille, Paris, 1868, which book can be found in the British Museum, the "Press Mark" being "8,755 a, a, a," as heretofore stated by me in the ELECTRICAL REVIEW of April 11th, 1885.

In the ELECTRICAL REVIEW of March 1st, 1884, page 187, will be found Bourseul's receiver, and in Baille's book will be found his description of Bourseul's receiver in the following words, "At the extremity of the line the current enters an electro-magnet, which attracts another vibrating plate of size and quality identical with the former." In the description of Bourseul's instrument to be found in the ELECTRICAL REVIEW, March 1st, 1884, page 187, the vibrating plate is described, "As a metal disc which would be flexible enough to reproduce all the sound waves transmitted to it by the air." It is evident that the Cox-Walker receiver is purely and simply a Bourseul-Baille receiver.

It will be recollected that in the action of the United Telephone Company against Harrison Cox-Walker, Mr. Justice Fry, and subsequently the Master of the Rolls —the late Sir George Jessel, the ablest jurist on the bench—held that the Cox-Walker receiver was an infringement of Bell's receiver.

Now it is obvious that if the Bourseul receiver had been put in evidence in that case the decision would have been against the United Telephone Company. The Master of the Rolls in his decision said, "Though nobody knows how to make a receiving instrument, if we are told this is a telephone receiver that will give articulate sound, it would nevertheless be a publication though nobody knew how to work it." Now the Bourseul receiver was described in a printed book in the British Museum many years before the date of Bell's patent in England and in the United States.

Lord Justice Bowen, on the bench with the Master of the Rolls in the same case, said, "I can conceive an instrument being useless at the time when its use was not known, but which afterwards became useful."

It is therefore evident that the Bourseul-Baille-Cox-Walker receiver is not an infringement of Bell's receiver, and can be used in England. Your correspondent, J. G. Ross, as other correspondents before him, has erred in stating that the "English Mechanic Receiver" was described in Bell's patent and was disclaimed by him. The receiver described by Bell is shown in fig. 19 of his patent, and is described by him in the following words:—"The armature, A, fig. 19, is fastened loosely by one extremity to the uncovered leg, h, of the electro-magnet, E, and its other extremity is attached to the centre of a stretched membrane, n. A cone, C^2, is used to converge sound vibrations upon the membrane."

The words *like goldbeater's skin* do not appear in Bell's patent; it was subsequently wrongly interpolated in his disclaimer. On this point I refer your readers to your REVIEW of January 31st, 1885, p. 110, in a letter signed *Das Telephon*, which was my *nom de plume*.

The *membrane* telephone with a small piece of iron attached to the centre thereof, was *first* mentioned by *Bell* in his paper read before the Society of Telegraph-Engineers, October, 1877, which is the instrument known as the "English Mechanic." In Bell's disclaimer the words *like goldbeater's skin* were evidently interpolated so as to lead the public to believe the *membrane* disclaimed was "like goldbeater's skin," and that no other membrane, such as parchment, ebonite, mica, or wood could be used. The use of a membrane carrying an armature was made free to the public by the publication in the *English Mechanic*. I will add that the Glasgow receiver, exhibited by Sir William Thomson in September, 1876, three months before Bell's patent was filed, was not described in that patent. A receiver made with an iron disc about the 16th of an inch thick and fastened firmly at one point, so that it will not vibrate as a reed or bar, will reproduce articulate speech with more distinctness than any Bell receiver.

I submit, then, that there are three efficient receivers free to the British public, namely, the Bourseul-Baille-Cox-Walker receiver, the "English Mechanic" receiver, and the Glasgow receiver.

There are many other excellent receivers, but they are patented in England and in the United States.

W. C. Barney.

New York, *July 8th*, 1887.